4.3 BIOLOGICAL RESOURCES

This section presents the existing environment and impacts analysis of biological resource issues associated with the granting of a new lease to Chevron to continue to operate the Long Wharf in San Pablo Bay. Section 4.3.1, Environmental Setting, provides information on biological resources in the San Francisco Bay Estuary and, in more detail, for the project area San Pablo Bay as well as the immediate vicinity of the Long Wharf Section 4.3.2, Regulatory Setting, describes the regulatory framework on a Federal, State, and local level.

Section 4.3.4, Impacts Analysis and Mitigation Measures, is the impacts analysis with mitigation measures. Biological resources have the potential to be impacted by routine operations related to the Long Wharf or by an accidental release of crude oil or product. Impacts of routine operations are analyzed first followed by a discussion of potential oil spill impacts. A spill of crude oil or product could have wide ranging effects on biological resources in San Francisco Bay. Finally, alternatives and cumulative impact analyses are presented in Sections 4.3.5, Impacts of Alternatives, and 4.3.6, Cumulative Projects Impacts Analysis.

4.3.1 Environmental Setting

4.3.1.1 San Francisco Bay Estuary

Biological Characteristics of the Estuary

Because tankers that service the Long Wharf travel throughout San Francisco Bay, all of the tidally influenced biological resources of the estuary may be at some risk from operations at the Long Wharf. Therefore, this section provides a brief overview of the biological resources of the estuary. The tidally influenced biological resources of the San Francisco Bay estuary are described in detail in the Unocal EIR (Chambers Group 1994).

The San Francisco Bay estuary, which extends from the mouth of Coyote Creek near the city of San Jose in the south to Chipps Island at the eastern end of Suisun Bay, is the largest coastal embayment on the Pacific Coast of the United States (Figure 4.3-1). It has a surface area of 450 square miles (1,166 square kilometers km^2). San Francisco Bay is located at the mouth of the Sacramento-San Joaquin River system, which carries runoff from 40 percent of the surface area of California (Nichols et al. 1986). The Bay is characterized by broad shallows with an average depth of 6 meters (m) MLLW (Conomos et al. 1985). The deepest sections of the Bay are channels at the Golden Gate (360.9 ft, 110 m depth) and Carquinez Strait (88.6 ft, 27 m depth), whose depths are maintained by strong tidal currents. As shown in Figure 4.3-1, the San Francisco estuary consists of five distinct subareas: Suisun Bay, Carquinez Strait, San Pablo Bay, Central Bay, and South Bay. Each of these areas has its own characteristic biological assemblage.

Figure 4.3-1 –

Reduction in freshwater inflows from the Sacramento and San Joaquin Rivers has profoundly altered the aquatic environment of the estuary. The freshwater inflow to San Francisco Bay is less than 50 percent of historic levels (Monroe and Kelly 1992). Diversion of water from the Sacramento-San Joaquin River system away from San Francisco Bay has had profound effects on the marine resources of the Bay, most noticeably on the anadromous fishes such as striped bass and salmon, which live part of their lives in the open ocean but depend on the rivers for spawning. The CALFED Bay-Delta Program was established by State and Federal agencies in 1994 to find a long-term solution to water supply and environmental problems in the Bay and Delta (CALFED 1998). In 2004, only 75 percent of total estimated annual runoff from the Sacramento-San Joaquin watershed reached the Bay (Bay Institute 2005a). This was an improvement over conditions two years earlier when 50 percent of the total runoff was diverted. However, the overall diversion of 37 percent of the runoff from the Bay since 2000 represents a continuing increase in flow diversions compared to an average of 36 percent diverted in the 1990s and 33 percent in the 1980s.

The biological resources of San Francisco Estuary also have been affected profoundly by the introduction of non-indigenous species. Introduced species are discussed in detail in the next section.

Phytoplankton production is the major source of organic matter in the estuary (Jassby et al. 1996; USACE, EPA, BCDC, SFBRWQCB, and SWRCB 1998). While the phytoplankton community in Central Bay is similar to the open ocean, the community in the northern reaches of the estuary is unique and has undergone profound changes in the last two decades. Phytoplankton distribution in the northern reach is characterized by an extremely high population in the entrapment zone, which usually occurs near the 2 parts per thousand (ppt) isohaline (San Francisco Estuary Project 1997). This zone of high production is important to several fish species (Kimmerer et al. 1998). In addition to a high concentration of phytoplankton, maximum abundances of several species of zooplankton occur in the entrapment zone (Kimmerer et al. 1998). The entrapment zone is usually positioned in Suisun Bay in spring and summer. The complex interactions between movement of the salt field, gravitational circulation, and retention of particles and organisms in the entrapment zone are currently being studied (San Francisco Estuary Project 1997). There have been recent reductions in the abundance of phytoplankton in Suisun Bay, apparently because of intensive filter feeding by the Asian clam, *Potamocorbula amurensis* (Herbold et al. 1991), an invasive introduced species, first reported in the estuary in 1986. Phytoplankton populations in the northern reaches of the Estuary may now be continuously and permanently controlled by introduced clams (Cohen and Carlton 1995). Since the appearance of *Potamocorbula* the summer diatom bloom has disappeared, presumably because of increased filter feeding (Kimmerer 1998). The *Potamocorbula* population in the northern reaches of the estuary can filter the entire water column over the channels more than once per day and over the shallows almost 13 times per day (Cohen and Carlton 1995).

In 2004, the Suisun Bay phytoplankton biomass remained critically low, less than 20 percent of average levels measured 25 years earlier (Bay Institute 2005a). Although phytoplankton in Suisun Bay declined dramatically, phytoplankton levels increased in South and Central Bays in 2004 and were stable in San Pablo Bay.

Historically, the most abundant zooplankton species in San Francisco Bay was the copepod, *Acartia clausi* (Davis 1982). In the northern reach, this coastal species was found with zooplankton species such as *Eurytemora affinis* characteristic of brackish waters (Painter 1966, Kimmerer and Orsi 1996, USACE and Contra Costa County 1997). Dominant zooplankters distribute themselves in the estuary according to salinity. *Acartia clausi* is found in more saline water. *Eurytemora affinis* is always most abundant near fresh water in salinities less than 10 ppt.

Most species of copepods have shown pronounced long-term declines in abundance in the San Francisco Bay estuary system (Herbold et al. 1991, CalFed 1998). Invasion of the western Delta and Suisun Bay by the introduced copepods, *Sinocalanus doerri*, in 1978 and *Pseudodiaptomus forbesi* in 1987, was followed by declines in *Eurytemora affinis* and the almost complete elimination of another copepod, *Diaptomus* spp. Most copepods, including *Acartia*, have been at low abundance in Suisun Bay since the arrival and spread of the Asian clam. Research suggests that the decrease in *E. affinis* in Suisun Bay was by direct loss to clam filtration (Lehman 1998).

In 2004, virtually all copepods found in Suisun Bay were not native to the Bay (Bay Institute 2005a). Because most non-native copepods are smaller than native species, average zooplankton size was just 20 percent of that measured for zooplankton in the 1970's. Current numbers of exotic copepod species are dominted by a small non-native copepod *Limnoithona tetraspina* (Bay Institute 2004).

The opossum shrimp, *Neomysis mercedis*, is an especially important zooplankton species in the northern reach because it is the dominant species in the diet of young-of-the-year fishes (Orsi and Knutson 1979). This species is most abundant at salinities up to 10 ppt and is almost never found at salinities greater than 20 ppt (Davis 1982). *Neomysis* is found in most abundance in Suisun Bay and the western Delta (Herbold et al. 1991). *Neomysis* abundance is related to outflows from the Delta. When outflows are high, phytoplankton populations spread out into the broad shallows of Suisun Bay; light levels are high and a bloom occurs providing more food for opossum shrimp (Herbold and Moyle 1989). During years of low flows, the entrapment zone moves upstream into the deep channels of the Sacramento River, and productivity declines with a subsequent decline in *Neomysis* populations. The *Neomysis* population remained variable but relatively high until 1987 when the population experienced a precipitous decline (Bay Institute 2004). The decline was coincident with the invasion of the Asian clam which appears to compete with *Neomysis* for phytoplankton. Since 1997 the average abundance of *Neomysis* is less than 0.1 percent of its abundance during the 1970's. In 2004, mysid shrimp were virtually absent from Suisun Bay (Bay Institute 2005a).

The observed declines in zooplankton abundance have roughly coincided with the decline in phytoplankton, one of the main food sources for zooplankton (CALFED 1998). The deterioration of the zooplankton community and its phytoplankton food supply in key habitat areas of the Bay-Delta is a serious problem because striped bass (*Morone saxatilis*), Delta smelt (*Hypomesus transpacificus*), Chinook salmon (*Oncorhynchus tshawytscha*), and other species that use Suisun Bay and the Delta as a nursery area feed almost exclusively on zooplankton during early life.

Except for limited areas of natural rocky shores near the Golden Gate and in Central Bay, and manmade hard substrate in the form of riprap, docks, and pilings, most of the substrate throughout the San Francisco Bay estuary consists of soft bottom. Almost all the common benthic invertebrates in San Francisco Bay are introduced species. As with the plankton community, each of the Bays of San Francisco estuary has its own characteristic soft bottom benthic community (Davis 1982). The distribution of soft bottom benthic species in San Francisco Bay is most closely correlated to temporal variations in salinity and to sediment type (Lowe 1999). The greatest number of species is found in Central Bay, which most closely resembles that of the open ocean. Away from the marine environment of Central Bay, the benthos is characterized by low diversity and dominated by a few species that are common to many North American estuaries and are tolerant of wide variations in salinity. Because most of the estuary is dominated by these few opportunistic species, the species compositions of the intertidal mudflats, the shallow subtidal, and the ship channels are similar. In general, the shallow subtidal supports a greater number of species than either the intertidal mudflats or the ship channels.

Special interest benthic species in San Francisco Bay include Dungeness crabs, grass shrimp, and a plant, eelgrass. Dungeness crab (*Cancer magister*) is a valuable commercial fishery for San Francisco and has been for over a century (USACE, EPA, BCDC, SFBRWQCB, and SWRCB 1998). San Francisco Bay is an important nursery area for Dungeness crabs (Tasto 1979; Herbold et al. 1991). Studies have demonstrated that Dungeness crab reared in San Francisco Estuary grow at about twice the rate of ocean-reared crabs (Baxter et al. 1999). Dungeness crabs enter San Francisco Bay as juveniles during March through June (Baxter et al. 1999). By September young crabs are widely distributed in San Pablo and lower Suisun Bays. The crabs leave the Bay by August or September of the following year. Dungeness crabs are particularly abundant from Richardson’s Bay upstream through Suisun Bay, showing greater abundance upstream during years of low outflow. San Pablo Bay is the area of most consistently high numbers of juvenile Dungeness crabs. In 2004, the abundance of young Dungeness crabs in the Bay was the third highest since monitoring began in 1980 and double that measured two years earlier (Bay Institute 2005a).

The smaller epibenthic fauna of San Francisco Bay is dominated by four species of shrimp known as grass shrimp (Herbold et al. 1991, Reilly et al. 2001). These shrimp are important prey for estuary fishes and also support a commercial bait fishery (USACE, EPA, BCDC, SFBRWQCB, and SWRCB 1998). Grass shrimp include three native species (*Crangon franciscorum*, *C. nigricauda*, and *C. nigromaculata*) and one introduced species (*Palaemon macrodactylus*). *Crangon franciscorum* (California bay shrimp) are most abundant in lower salinities with young occurring in water that is almost fresh; *C. nigricauda* (blacktail bay shrimp) prefer salinities of 25 ppt or more; and *C. nigromaculata* (blackspotted bay shrimp) are seldom found at salinities below 30 ppt (Herbold et al. 1991). *Palaemon macrodactylus* is most common in lower salinity areas (Reilly et al. 2001). The center of its distribution is Suisun Bay and the West Delta. Overall abundance of shrimp in the Bay doubled during the past decade (Bay Institute 2005a). In 2004, shrimp abundance in Central Bay was more than twice as high as in any other region of the Bay, suggesting that most shrimp in the Bay are marine rather than estuarine species.

Eelgrass (*Zostera marina*) is an important shallow subtidal and intertidal flowering plant of bays and estuaries. Eelgrass beds are recognized as a particularly valuable type of marine habitat that enhances the physical and biological environment where they occur (Phillips 1988). Eelgrass beds are highly productive (Ware 1993). In addition, these beds stabilize the substrate and add structure to the monotonous soft bottom. Several studies have demonstrated that the marine life in eelgrass meadows is enhanced in numbers, species, and standing crop compared to unvegetated soft bottom habitat (summarized in Ware 1993). Eelgrass beds in San Francisco Estuary are found from lower San Pablo Bay to South Bay at Coyote Point. The depth range of eelgrass in San Francisco Bay is from 1.3 feet (0.4 meters) above Mean Lower Low Water (MLLW) to 5.8 feet (1.77 meters) below MLLW (Merkel 2004). Eelgrass habitats are dynamic, expanding and contracting by as much as several hectares per season, depending on the variations in key environmental factors. The eelgrass beds in San Francisco Bay also have been observed to fluctuate in density and abundance from year to year (Merkel 2004). In the summer of 2003, 2,880.5 acres of eelgrass were mapped in San Francisco Bay (Merkel 2004). The abundance of eelgrass in 2003 represents a 900 percent increase from the previous baywide eelgrass survey in 1987, which mapped 316 acres of eelgrass in San Francisco Bay (Wyllie-Escheverria and Rutten 1989). Part of the increase is a result of superior mapping techniques but most of the increase is thought to represent a real increase in eelgrass cover in the Bay. Table 4.3-1 shows the location and coverage of eelgrass in San Francisco Bay in the 1987 and 2003 surveys. By far the largest eelgrass bed in the Bay is the Point San Pablo Bed, which is located between Point Pinole and Point San Pablo north of the Richmond- San Rafael Bridge.

Table 4.3-1
Location and Acreage of Major Eelgrass Beds in San Francisco Bay
During the 1989 and 2003 Surveys

LOCATION	1987		2003	
	(ha.)	(ac.)	(ha.)	(ac.)
San Pablo Bay	50.2	124	608.9	1,504.5
Point Orient	1.2	3	0.9	2.3
Naval Supply Depot	4.9	12	31.2	77.0
Point Molate Beach	10.5	26	13	32.0
Toll Plaza West	0.2	0.5	0	0.0
Toll Plaza East	0.2	0.5	1	2.5
Point Richmond, North	2.8	7	9.7	24.0
Point Richmond, South	1.6	4	26.5	65.6
Richmond Breakwater, North	7.3	18	7.7	19.0
Richmond Breakwater, South	2.8	7	35	86.3
Brickyard Cove	-	-	7.2	17.7
Emeryville (breakwater)	5.3	13	11.6	28.7
Emeryville Flats	-	-	8.7	21.6
Yerba Buena Island	-	-	0.7	1.7
Treasure Island	-	-	2.1	5.1
Alameda	22.3	55	109	269.9
Bayfarm, North	0.8	2	1.8	4.4
Bayfarm, South	1.6	4	51.8	127.9
Coyote Point	0.4	1	0.2	0.6
Richardson Bay	5.3	13	176.7	436.7
Angel Island West	1.2	3	0.6	1.6
Angel Island South	-	-	0.3	0.7
Angel Island East	-	-	1.1	2.8
Belvedere Cove	2.0	5	8.8	21.8
Point Tiburon	0.4	1	0.1	0.2
Keil Cove	4.0	10	8.3	20.4
Paradise Cove, North	1.6	4	5.3	13.0
Paradise Cove, South	1.2	3	0.1	0.2
Pt. San Quentin	-	-	0.2	0.5
Pt. San Pedro	-	-	0.6	1.6
Minor Beds and Patches	-	-	36.5	90.2
Total	**127.9**	**316**	**1,165.7**	**2,880.5**
Source: Merkel 2004				

Over 100 species of fish have been recorded from the San Francisco Bay estuarine system (Armor and Herrgesell 1985). These species vary in the way they use the Bay, from those that spend their entire lives in the Bay to those that spend only part of their life cycle there. The only fish species confined entirely to the Bay-Delta estuary is the Delta smelt, although the ecologically similar longfin smelt (*Spirinchus thaleichthys*) occurs very rarely outside the Golden Gate (Herbold et al. 1991). All other species maintain at least part of their population outside the San Francisco Bay-Delta estuary system. In general, the fishes of the San Francisco estuary fall into four categories: true estuarine species, freshwater species, marine species, and anadromous species

(USACE, EPA, BCDC, SFBRWQCB, SWRCB 1998). San Francisco Bay is basically a marine environment, although salinities can be appreciably diluted by freshwater during high outflow years allowing freshwater fishes to move into the tributary streams (Moyle 2002).

Marine species include those which are only seasonally present and those that maintain at least part of their population in San Francisco Bay year-round. Seasonal species comprise many of the most abundant species found in the Bay (Herbold et al. 1991). Abundant seasonal species include northern anchovy (*Engraulis mordax*) and Pacific herring (*Clupea harengus*).

Anadromous species are those that spend their adult lives in the open ocean and come into fresh water to spawn. Anadromous species use the San Francisco Bay estuary on their way up the rivers to spawn and as a rearing area for juveniles on their way down from their birthplace in the river to the open ocean (Herbold et al. 1991). Native anadromous species include Chinook salmon, steelhead trout (*Oncorhynchus mykiss gairdneri*) and both green and white sturgeon (*Acipenser medirostris* and *A. transmontanus*). Introduced anadromous species include striped bass (*Morone satatilis*), and American shad (*Alosa sapidissima*). Anadromous species are sensitive to a wide variety of environmental changes, including upstream alteration of spawning habitat, interference with access to spawning habitat, changes in flow patterns, and conditions in the estuary that reduce its value as a nursery site for out migrating young (Herbold et al. 1991).

Table 4.3-2 summarizes use of the Bay by the most important fish species. Special status fish species are discussed under that section header.

Vegetated tidal marshes are an extremely productive and important habitat in the San Francisco estuary. More than 91 percent of the tidal wetlands in San Francisco Bay estuary have been lost to reclamation for farmland, salt evaporation ponds, and residential or industrial development (USGS 2002). Recent efforts have been made to protect and restore tidal marshes in the Bay. Three types of tidal marshes, related to extent of freshwater influence, are found in the San Francisco Bay estuary: saltmarsh, brackish marsh, and freshwater marsh. These marshes are exposed to the rise and fall of tides and are characterized by emergent vascular plants. Tidal cycles affect the vertical extent of marshes as well as their inundation period and tidal flushing.

Table 4.3-2
Representative Fishes of San Francisco Bay and the Delta

Species	Species Origin	Species Type	Life History			Center of Population	Importance of Species	Preferred Habitat	Use of Bay or Delta	Major Food Source		Recent Population Trend
			Spawning Time	Spawning Location	Nursery Area					Adult	Juvenile	
Pacific herring	N	M	Fall-Winter	Bay	SSFB-SPB	Ocean	Commercial, Forage	Pelagic	Bay-Spawning, Nursery	P	P	Variable
Longfin smelt	N	E	Winter-Spring	Rivers	Delta, Bay	SPB	Forage	Pelagic	Bay-Nursery, Residence	P	P	Variable, recently down
Pacific staghorn sculpin	N	E	Fall-Winter	Bay, Ocean	Bay	CSFB-SPB	Forage	Littoral/ Demersal	Bay-Nursery, Residence	F, B	B	Variable
Starry flounder	N	E	Winter	Ocean	SB-Delta	Ocean-Bay	Commercial, Recreation	Demersal	Bay-Nursery, Residence	B	B	Down
Speckled sandab	N	M	All Year	Ocean	Ocean-CSFB SPB SSFB	Ocean	Forage	Demersal	Bay-Nursery, Residence	B	B	Variable
English sole	N	M	Winter	Ocean	Ocean-Bay	Ocean	Commercial	Demersal	Bay-Nursery	B	B	Variable
White croaker	N	M	Summer-Fall	Ocean	Ocean-CSFB	Ocean	Forage	Demersal	Bay-Residence	B	B	Up
Yellowfin goby	I	E	Winter	Bay	SB-Delta	SPB-SB	Forage, Commercial	Demersal	Bay-Residence	B	B	Down
Plainfin midshipman	N	M	Spring-Summer	Bay	SSFB-SPB	CSFB-SPB	Forage	Demersal	Bay-Nursery, Residence	B	B	Up
Bay goby	N	M	Summer-Fall	Bay	SSFB-SPB	CSFB	Forage	Demersal	Bay-Nursery, Residence	B	B	Variable
Topsmelt	N	M	Summer	Bay	SSFB-CSFB	SSFB	Forage	Littoral/ Pelagic	Bay-Residence	B	B	Variable
Jacksmelt	N	M	Spring-Summer	Bay, Ocean	SSFB-CSFB	Ocean	Recreation, Forage	Pelagic	Bay-Spawning, Nursery	F	P	Variable
Northern anchovy	N	M	Spring-Summer	Bay, Ocean	Bay, Ocean	Ocean	Commercial, Forage	Pelagic	Bay-Spawning, Nursery	P	P	Variable
Pacific lamprey	N	A	Spring	Rivers	Rivers, Upper Delta		Parasite, Forage	Pelagic	Upper Delta-Nursery, Migration	F	B veg.	Down
White sturgeon	N	A	Spring	Rivers	Estuary		Recreation	Demersal	Delta-Residence	P	P	Down
American shad	I	A	Spring	Rivers, Upper Delta	Rivers, Delta		Recreation	Pelagic	Bay & Delta, Nursery, Migration	P	P	Down
Threadfin shad	I	FW	Spring	Delta	Delta		Forage, Bait, Commercial	Pelagic	Delta-Residence	P	P	Down
Steelhead trout	N	A	Spring	Rivers	Rivers		Recreation	Pelagic	Bay & Delta-Migration	P	P, B, insects	Down
Chinook salmon	N	A	All months, greatest nos. in fall	Rivers	Rivers, Upper Delta		Recreation, Commercial	Pelagic	Delta-Nursery, Migration, Bay-Migration	F, P	P, insects	Down

Table 4.3-2 (Continued)
Representative Fishes of San Francisco Bay and the Delta

Species	Species Origin	Species Type	Life History			Center of Population	Importance of Species	Preferred Habitat	Use of Bay or Delta	Major Food Source		Recent Population Trend
			Spawning Time	Spawning Location	Nursery Area					Adult	Juvenile	
Delta smelt	N	E	Spring	Delta	Delta, Suisun Bay		Forage	Pelagic	Delta-Spawning, Nursery, Residence	P	P	Down
Splittail	N	E	Spring	Delta	Delta, Suisun Bay		Recreation, Forage	Pelagic	Delta-Spawning, Nursery, Residence	P	P	Down
Carp	I	FW	Spring	Delta	Delta		Recreation	Pelagic	Delta-Spawning, Nursery, Residence	P	P	Down?
Sacramento sucker	N	FW	Spring	Rivers	Rivers		Educational	Demersal	Delta-Nursery	B	B	?
White catfish	I	FW	Spring-Summer	Delta	Delta		Recreation	Demersal	Delta-Spawning, Residence	B	B	Down
Striped bass	I	A, E	Spring	Rivers, Delta	Delta, San Pablo Bay		Recreation	Pelagic/ Demersal	Delta-Spawning, Nursery, Bay-Nursery	P, B,F	P	Down
Bluegill	I	FW	Spring	Delta	Delta		Recreation	Littoral	Delta-Spawning, Nursery	P, B	P, B	?
Black crappie	I	FW	Spring	Delta	Delta		Recreation	Pelagic	Delta-Spawning, Nursery, Residence	P, F	P	?
Largemouth bass	I	FW	Spring	Delta	Delta		Recreation	Littoral	Delta-Spawning, Nursery, Residence	F, B	P, B	?
Tule perch	N	E	Spring, live bearer	Delta, marsh sloughs	Delta, marsh sloughs		Educational	Littoral	Delta-Nursery	B, P	B,P	Down?

Species Code
N = native
I = introduced
E = estuarine
M = marine
A = anadromous
FW = freshwater
Source: Monroe and Kelly 1992.

Nursery Area Code
SSFB = South San Francisco Bay
CSFB = Central San Francisco Bay
SPB = San Pablo Bay
SB = Sulsan Bay

Major Food Source Code
P = plankton
B = benthos
F = fish pelagic
Pelagic = open water
Littoral = shoreline
Demersal = bottom

Dominant plant species define the three marsh types, and zonation patterns of the dominant species within the marshes are apparent. In general, saltmarsh wetlands are dominated by Pacific cordgrass (*Spartina foliosa*) and pickleweed (*Salicornia virginica*), brackish marshes are dominated by various species of bulrush, and freshwater marshes are dominated by bulrush, reed grass (*Phragmites communis*), and cattails (*Typha* spp.). Differences in species composition between tidal marshes and plant zonation within marshes are based on plant physiological responses to physical factors of inundation, salinity, and sedimentation. In addition, interspecific competition can be a significant factor determining plant distributions in tidal marshes. Because most marsh plants reproduce vegetatively, each species can respond relatively quickly to favorable physical conditions and, therefore, seasonality can also affect the patterns of plant distribution in the tidal marshes (Josselyn 1983).

Tidal marsh occurs throughout the San Francisco estuary. Approximately 75 percent of San Francisco Bay's tidal marshes are in Suisun Bay (32 percent) and San Pablo Bay (42 percent) (Bay Institute 2005a). The largest areas of tidal marsh are on the northern edge of San Pablo Bay and along the Petaluma River. Suisun Bay, too, supports a substantial acreage of tidal marsh, while Central Bay supports relatively little. Since 1998 more than 2500 acres of tidal marsh in San Francisco Bay have been restored (Bay Institute 2005a).

In addition to tidal wetlands, the San Francisco estuary includes diked wetlands, areas that have been isolated from natural tidal action. The largest area of diked wetlands is in the northern part of Suisun Bay and the Sacramento-San Joaquin Delta.

San Francisco Estuary is vitally important to many species of water-associated birds. San Francisco Estuary is important as a major refuge for many species of shorebirds and waterfowl during their migration and wintering season (August through April) and it provides breeding habitat during the summer for several species (including the endangered California least tern (*Sterna antillarum browni)* and threatened western snowy plover (*Charadrius alexandrinus nivosus)*). Habitat types in contact with tidal waters (and potentially spilled oil) in San Francisco Estuary include open water, rocky shore, intertidal mudflats, and tidal marshes. Each has a characteristic fauna.

The avifauna of open water includes loons and grebes, pelicans and cormorants, gulls and terns, and a variety of waterfowl including ducks and scoters. Table 4.3-3 shows the avifauna most susceptible to oil spills. The San Francisco Bay region has been identified as one of 34 waterfowl habitat areas of major concern in the North American Waterfowl Management Plan (USFWS 1989). More than 30 species of waterfowl are found in the San Francisco Bay ecosystem (Goals Project 1998). Mid-winter surveys from 1998 to 2000 found scaup (*Aytha sp.)* comprise 43.2 percent of all waterfowl in the entire San Francisco Estuary, 64 percent of all waterfowl on open water in South Bay, and 67 percent of all waterfowl on open water in Central Bay (URS 2002). The second most abundant waterfowl in San Francisco Bay were scoters, which accounted for 25 percent of the waterfowl in South Bay and 29 percent of the waterfowl in Central Bay.

Table 4.3-3
Characteristic Bird Fauna of Habitat Types
Most Susceptible to Oil Spill Impacts

Typical Species	Seasonal Status
Open Water	
Red-throated loon	Winter resident
Common loon	Winter resident
Horned grebe	Winter resident
Western grebe	Winter resident
Clark's grebe	Winter resident
Brown pelican	Summer, fall resident
Double-crested cormorant	Year-round resident
Pelagic cormorant	Year-round resident
Canvasback	Winter resident
Scaup spp.	Winter resident
Surf scoter	Winter resident
American coot	Year-round resident
Western gull	Year-round resident
Glaucous-winged gull	Winter resident
Caspian tern	Summer resident
Forster's tern	Year-round resident
Rocky Shore	
Brown pelican	Summer, fall resident
Black oystercatcher	Year-round resident
Wandering tattler	Winter resident
Spotted sandpiper	Winter, spring resident
Black turnstone	Winter resident
Surfbird	Winter resident
Elegant tern	Summer, fall migrant
Intertidal Mudflats	
Western grebe	Winter resident
Great blue heron	Year-round resident
Great egret	Year-round resident
Snowy egret	Year-round resident
American wigeon	Winter resident
American avocet	Summer, winter resident
Willet	Year-round resident
Marbled godwit	Year-round resident
Western sandpiper	Winter resident
Dunlin	Winter resident
Dowitcher spp.	Winter resident
Forster's tern	Year-round resident
Great blue heron	Year-round resident
Great egret	Year-round resident
Snowy egret	Year-round resident
Northern pintail	Summer, winter resident
Northern harrier	Year-round resident
Black rail	Year-round resident
California clapper rail	Year-round resident
Virginia rail	Year-round resident
Sora	Year-round resident
American coot	Year-round resident
Willet	Year-round resident

Table 4.3-3 (continued)
Characteristic Bird Fauna of Habitat Types
Most Susceptible to Oil Spill Impacts

Typical Species	Seasonal Status
Short-eared owl	Year-round resident
Common yellowthroat	Year-round resident
Song sparrow	Year-round resident
Tidal Freshwater Marsh	
Pied-billed grebe	Year-round resident
American bittern	Year-round resident
Virginia rail	Year-round resident
Sora	Year-round resident
Common moorhen	Year-round resident
American coot	Year-round resident
Marsh wren	Year-round resident
Source: USFWS 1992.	

Rocky shores provide foraging habitat for turnstones and oystercatchers, and roosts for cormorants, pelicans, gulls, and terns. Intertidal mudflats are predominantly populated by shorebirds, and the mudflats of San Francisco Bay are of critical importance in the winter as feeding/staging areas for migrating shorebirds on the Pacific Flyway. The San Francisco Bay estuary is used by over one million shorebirds during spring migration and is home to several hundred thousand during winter (Hui et al. 2001). A recent study of shorebird abundance and distribution on the Pacific Coast of the United States found that San Francisco Bay accounted for many more shorebirds than any other wetland in all seasons (Page et al. 1999). Most shorebird use occurs in the southern reach of the estuary (South Bay) (Hui et al. 2001). Tidal salt and brackish marshes provide essential habitat to support clapper and black rails (*Rallus longirostris obsoletus* and *Laterallus jamaicensis conturniculus*), herons and egrets, the salt-marsh yellowthroat (*Geothlypis trichas sinuosa*), and saltmarsh song sparrows (*Melospiza melodia*).

Three species of marine mammals can be included in the resident fauna of the San Francisco Bay region: the harbor porpoise (*Phocoena phocoena*), the harbor seal (*Phoca vitulina*), and the California sea lion (*Zalophus californianus*). Gray (*Eschrichtius robustus*) and humpback whales (*Megaptera novaeangliae*) may occasionally wander into the Bays but typically live off the open coast. Visits of these species have occurred in recent years as migrating animals strayed into the Bays during coastwise migration in the winter/spring (gray whales) or fall (humpback whales).

Introduced Species

Over 230 non-native species have become established in the San Francisco estuary (Cohen 1998). Exotic species dominate many of the estuary's aquatic assemblages, including soft bottom benthic communities, fouling communities, brackish-water zooplankton in the northern reach, and freshwater fishes. In these communities, introduced species may account for 40 to 100 percent of the common species, up to 97 percent of the total organisms, and up to 99 percent of the biomass (Cohen 1998). Furthermore, the rate of invasions has been increasing. About half of the exotic species identified in the San Francisco estuary were first recorded within the last 35 years. The rate of invasions has increased from about one new species established every 55 weeks between 1851 and 1960 to one new species established every 14 weeks from 1961 to 1995 (Cohen 1998). Some of these invasions have greatly altered habitat structure and nutrient and contaminant pathways. In addition, introduced species have contributed to reductions and extinctions of native species through predation, competition, and the introduction of parasites (San Francisco Estuary Project 1997).

A recent survey by CDFG for non-indigeneous aquatic plants and animals in California revealed that all areas of the California coast have experienced some level of invasion by species not native to the state or not native to the area of the coast where they recently have been discovered (CDFG 2002). The survey found 747 taxa that are introduced or most likely introduced. The highest numbers of introduced species were found in the two major commercial pots of San Francisco and Los Angeles/Long Beach. The majority of the species introduced to California appear to have come from the northwest Atlantic, the northwest Pacific and the northeast Atlantic.

The Asian clam (*Potamocorbula amurensis*) is an example of a species that was recently introduced to the detriment of the natural ecosystem. This euryhaline clam, first collected in 1986, appears to have been introduced as larvae in the seawater ballast of cargo vessels (Carlton et al. 1990). Within 2 years, it spread throughout the estuary, where it reached densities in some areas of over 10,000 individuals per square meter. Nichols et al. (1990) suggest that the Asian clam may have permanently displaced the native benthic community in parts of Suisun Bay. In addition, overgrazing by these large populations of the Asian clam appears to have decimated the phytoplankton in Suisun Bay (Cohen and Carlton 1995, Thompson 2000, San Francisco Estuary Project 1997). Conservative estimates of grazing rates suggest that this clam population is capable of filtering the water column one to two times per day in the shallow waters of Suisun Bay. Asian clams also consume young stages of copepods and compete with mysid shrimp and other zooplankton species for food. Several small crustaceans, including copepods and mysid shrimp, declined sharply in abundance and range following the spread of the clam (San Francisco Estuary Project 1997).

Two recently introduced crab species, the green crab (*Carcinus maenas*) and the Chinese mitten crab (*Eriocheir sinensis*), also pose a threat to the ecosystem. The green crab, a native of the European Atlantic coast, was first collected in San Francisco Bay in 1989 to 1990 (Cohen et al. 1995). It has become abundant in intertidal and shallow subtidal areas and has spread throughout Central Bay, South Bay, and San Pablo Bay to Carquinez Strait. Salinity limits the green crab's distribution (San Francisco Estuary Project 2004). Few have been collected from water with a salinity below 10 ppt. The green crab may have arrived in ballast water, on ship hulls, amongst algae with imported live bait or lobsters, or by intentional release. The green crab is a voracious predator that has been documented to have reduced bivalve populations in New England and Europe (Cohen et al. 1995). Competition with the green crab for food resources could affect shorebirds and possibly the Dungeness crab (San Francisco Estuary Project 1997).

The Chinese mitten crab was first collected in south San Francisco Bay in 1992 and has since spread rapidly throughout the estuary (Veldhuizen and Hieb 1998). It was collected in San Pablo Bay in 1994 and Suisun Marsh and the Delta in 1996. In 1996, a total of 45 mitten crabs were collected from the Delta, Suisun Bay, and Suisun Marsh. By 1997, the number of mitten crabs captured in the Delta rose to over 20,000. Adult mitten crab abundance in San Francisco Bay peaked between 1998 and 2001 (San Francisco Estuary Project 2004). The mitten crab population declined in 2002 and 2003. The most probable mechanism of introduction in California was either deliberate release to establish a fishery or accidental release via ballast water. The high density of mitten crab burrows in steep banks could accelerate bank erosion and slumping and threaten the structural integrity of levees in the Delta (San Francisco Estuary Project 1997). The mitten crab may also have profound effects on other species through competition (Veldhuizen and Hieb 1998).

The invasive burrowing isopod *Sphaeroma quoyanum* increases erosion in salt marshes by excavating dense burrow complexes along the banks of salt marsh channels (Talley et al. 2001). This species was introduced to San Francisco Bay, probably from the hulls of wooden ships, in the late nineteenth century.

Invasions of non-native species includes microorganisms. The Japanese foraminifer *Trochammia hadai* was first found in San Francisco Bay in sediment samples taken in 1983 and since 1986 has been collected at 91 percent of the sampled sites in the Bay, constituting up to 93 percent of the foraminiferal assemblage at individual sites (McGann et al. 2000). The proliferation of *T.hadai* in San Francisco Bay is associated with a decline in relative abundance of one of the most common native foraminifers *Elphidium excavatum. T.hadai* probably was transported from Japan in ships' ballast tanks, in mud associated with anchors, or in sediments associated with oysters imported for mariculture. Its remarkable invasion of San Francisco Bay suggests the potential for massive, rapid invasions by other marine microorganisms (McGann et al. 2000).

Exotic species have been introduced to the San Francisco estuary by deliberate fish introductions, in imported oyster cultures, from ship hulls, and by ballast water discharges. While the former mechanisms were important in the past, in recent years ballast water discharges are thought to be the primary means through which exotic species become established in the Bay (Cohen 1998, CDFG 2002). Of the exotic species that were first reported in the estuary in 1986 to 1995, between 47 and 77 percent arrived in ballast water (Cohen 1998). The more recent study by CDFG suggests that the percentage of non-indigenous species introduced to San Francisco Bay via ballast water may be closer to 30 to 35 percent (CDFG 2002). Hull fouling also appears to be a major introduction pathway in San Francisco Bay (CDFG 2002).

Ships take up ballast water when their cargo is unloaded, fuel is consumed, extra stability is needed due to heavy seas, or the ship is too tall to pass under a bridge. The weight of the water taken into a ship's holds lowers the vessel's profile and makes it more stable. When the ship takes up ballast, organisms in the water, mud or nearby pier pilings get pumped into the ships hold along with the water. When the ship reaches its destination, it may discharge the ballast in the port. Organisms stored in the holds are released to the new port where they may thrive.

Between 2.5 and 5 billion gallons of ballast water are estimated to be discharged to the San Francisco estuary per year (Cohen 1998). The average volume of ballast water discharged by tankers in the estuary has been estimated to be about 2.5 million gallons per tanker. Recent reporting of ballast water discharges by tank vessels in San Francisco Bay indicates that in 2004 and 2005 about 0.5 billion gallons of ballast water was discharged in San Francisco Bay (Falkner, CSLC, personal communication 2005).

Sampling of organisms in ship ballast water suggests that densities between 0.1 and 1 relatively large planktonic organisms per gallon and greater densities of smaller organisms may frequently be present in ballast water at the conclusion of a transoceanic voyage (Cohen 1998). Because the number and diversity of organisms decline substantially over the duration of a voyage, ships that travel shorter distances, such as most of the tankers servicing the Long Wharf, would have greater densities. A recent sampling of ballast water of coastal origin not exposed to ballast water exchange found that the mean number of zooplankton was 4.64 individuals per liter, the mean number of phytoplankton cells was 299,202 cells per liter, the mean number of bacteria was 8.3×10^8 bacteria cells per liter, and the mean number of virus-like particles was 7.4×10^9 per liter (MEPC 2003). Given the large capacity of ship's ballast water pumps, a single deballasting ship may therefore discharge into the environment millions of exotic phytoplankton and invertebrate zooplankton per hour, and larger numbers of protists, bacteria, and viruses.

The National Invasive Species Act was passed in 1996. This act prescribed mandatory regulations for the Great Lakes and Hudson River and added voluntary guidelines for the rest of the country. In 2004, ballast water management practices became mandatory for the rest of the country.

The California Ballast Water Management for Control of Nonindigenous Species Act was passed in 1999. This Act prescribes mandatory legislation for the waters of the State of California designed to reduce the introduction of invasive nonindigenous species to California waters. The California Marine Invasive Species Act of 2003, which became effective January 1, 2004, revised and expanded the 1999 Act.

Although ballast water discharges are probably responsible for the greatest number of non-indigenous species introduced to San Francisco Bay, recent data indicate ship fouling has a higher potential for exotic species introduction than previously believed

(Brancato 1999, RWQCB 2000, CDFG 2002). Reports from Germany and Australia found over 400 invasive species that were introduced in waters directly from the fouled hulls of ships. About one third of the exotic marine species in Australia harbors were determined to have been introduced via hull fouling.

Rare/Threatened/Endangered Species

Sensitive Plants

Listed plant species that occur in tidal wetlands in the San Francisco Bay region are presented in Table 4.3-4. Sensitive species associated with nontidal wetlands, such as vernal pools, are not included in this summary because they would not be impacted by the continued operation of the Long Wharf. The following section provides information on specific habitats, life history, and locations of the sensitive plants listed in Table 4.3-4.

Distributions of known sensitive plant populations in the study area within 250 feet (horizontal distance) of the shoreline were evaluated, based on records in the California Natural Diversity Database (CNDDB). This horizontal distance was used as a study limit under the presumption that it encompasses elevations up to a maximum of about +7 feet mean sea level (MSL) and thus includes all listed plant species that could be affected by a project related oil spill. In addition to the CNDDB records, there are a number of sensitive plant sites reported in Volume II of the Area Contingency Plan (USCG and OSPR 2000). The following text summarizes both the CNDDB and Contingency Plan data.

Tidal habitats of San Francisco Estuary support five plant species that are onFederal and/or tate lists as threatened, endangered, or rare: California seablite (*Suaeda californica*), marsh sandwort (*Arenaria paludicola*), Mason's lilaeopsis (*Lilaeopsis masonii*), soft bird's beak (*Cordylanthus mollis* ssp. *mollis*), and Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*). All of these species occur in marsh communities at various locations in the estuary, primarily around Suisun Bay and its tributary sloughs. In general, all marsh habitat in the Bay region can be considered actual or potential habitat for federally and/orState-listed threatened, endangered, or rare plant species, or species considered as such by the California Native Plant Society (CNPS).

Suisun Thistle (*Circium hydrophilum* var. *hydrophilum*)

This perennial herb is found in brackish marshes and in peaty soils around Suisun Bay in Solano County. It flowers from July through September. It is aFederal endangered species and a CNPS 1B species. According to the CNDDB (CDFG 2002), this plant occurs in the Suisun Marsh near Grizzly Island. Dominant species associated with the Suisun thistle were bulrushes, cinquefoil (*Potentilla* sp.), and rushes.

Table 4.3-4
Special Status Plant Species of
Tidal Marshes of the San Francisco Bay Region*

Common Name/Scientific Name	Status		Habitat
	State	Federal	
Marsh sandwort *Arenaria paludicola*	E	E	Fresh, Salt, and brackish marshes
Suisun thistle *Cirsium hydrophilum* var. *hydrophilum*	--	E	Brackish Marshes
Soft bird's beak *Cordylanthus mollis* ssp. *mollis*	R	E	Salt and brackish marshes
California seablite *Suaeda californica*	R	E	Salt marshes
Mason's lilaeopsis *Lilaeopsis masonii*	R	--	Brackish marshes

Federal Status (determined by USFWS)
E = Federally listed, endangered
State Status
T = State listed, threatened
E = State listed, endangered
R = State listed, rare
*** = Sensitive plant species in San Francisco Estuary that are on California Native Plant Society lists but not Federal or State lists include Suisun marsh aster (*Aster lentus*), Delta tule pea (*Lathyrus jepsoni* var *jepsoni*), and Delta mudwort (*Limosella sublata*)**
Sources: CDFG 2002.

Soft Bird's Beak (*Cordylanthus mollis* ssp. *mollis*)

This branched annual is found in the coastal salt and brackish marshes of the San Francisco Bay region. It flowers from July to November. It is a State rare species, Federal endangered species, and a CNPS 1B species. According to the CNDDB, several populations occur in San Pablo Bay, including the Tule Slough on the Petaluma River, in northern San Pablo Bay near Tubbs Island, in the upper Napa River marsh, and on the southern edge of San Pablo Bay east of Pinole Point. Several populations are found on the north side of the Carquinez Strait at Benicia, and in the Montezuma and Suisun Sloughs north of Grizzly Bay, and in the Shore Acres area in south Suisun Bay (CDFG 2002). Dominant species associated with the soft-haired bird's beak include saltgrass (*Distichlis spicata*), pickleweed (*Salicornia virginica*), Jaumea (*Jaumea carnosa*) and, occasionally, bulrushes.

Mason's Lilaeopsis (*Lilaeopsis masonii*)

This low, tufted perennial inhabits marshes and brackish flats made up of moist sand and mud in Solano County. It flowers from June through August. It is State-listed as rare, and is a CNPS 1B species. According to the Natural Diversity Data Base, populations range from the Napa River above the salt evaporators, north of San Pablo Bay, to the northern reaches of the Suisun and Montezuma Sloughs north of Grizzly Bay, with a majority of the populations found at the convergence of the Sacramento and

San Joaquin Rivers, including Brown's Island and the lower Sherman Marsh and throughout the Delta, with populations extending up both the San Joaquin and Sacramento Rivers (CDFG 2002). It extends west as far as Mare Island.

California Seablite (*Suaeda californica*)

California seablite is State rare and Federal endangered. It is a low-growing, evergreen, perennial shrub with fleshy leaves, in the goosefoot family (*Chenopodiaceae*). Occurrence records indicate a general association with coastal saltmarshes, but the description of its precise habitat seems to vary depending on what taxonomic reference is consulted. Collectively, the available information suggests that the species favors the upper saltmarsh zone and possibly the drier, sandy upland substrate that may be present above this zone. The reported elevation limit of the species is 4.5 meters (15 feet) MSL. It has been recorded in South Bay marshes and in the Delta.

Marsh Sandwort (*Arenaria paludicola*)

Marsh sandwort was listed by the CDFG as endangered in February 1990, and by the USFWS as endangered on August 3, 1993. It is a perennial, low-growing shrub in the pink family (*Caryophyllaceae*). The species has been observed most frequently in saltmarsh habitats and less frequently in freshwater marshes. It flowers between May and August. It has been found in the west Central Bay near the Golden Gate.

Other Sensitive Plant Species

Plant species considered sensitive by the CNPS but not on State or Federal lists that occur in tidal marshes in San Francisco Estuary include Suisun marsh aster (*Aster lentus*), Delta tule pea (*Lathyrus jepsoni* var *jepsonii*), and Delta mudwort (*Limosella sublata*). Suisun marsh aster and Delta tule pea are CNPS 1B species and Delta mudwort is a CNPS Category 2 species. Species designated as 1B by the CNPS are plants that are rare, threatened or endangered in California or elsewhere. List 2 plants are rare, threatened, or endangered in California but are more common elsewhere.

Suisun marsh aster occurs in brackish and freshwater marshes in Suisun Bay, the western Delta, and Carquinez Strait (CDFG 2002). It was observed near the Shore terminal pier during the 2002 reconnaissance survey of the project site. Delta tule pea tule pea occurs in freshwater and brackish marshes, primarily in the Delta. Within San Francisco Bay it has been recorded in Montezuma Slough (CDFG 2002).

Sensitive Fishes

Table 4.3-5 lists fish species in San Francisco Bay that appear on CDFG and/or USFWS species lists as endangered, threatened, a candidate for endangered or threatened, or a species of special concern.

Table 4.3-5
Special Status Fish Species of San Francisco Bay

Common Name/Scientific Name	Status		Habitat/Critical Habitat
	State	Federal	
River Lamprey *Lampetra ayresi*	CSC	--	Open water of Delta, Suisun Bay/NA
Green sturgeon *Acipenser medirostris*		Proposed T	Open water of Bay and Delta, Sacramento River
Delta smelt *Hypomesus transpacificus*	T	T	Open water of Delta, Suisun Bay/Suisun Bay into Delta
Longfin smelt *Spirinichus thaleichthys*	CSC	--	Open water of Bay and Delta/NA
Chinook salmon *Oncorhynchus tshawytscha* Winter run	E	E	Open water of Delta-nursery, migration; Bay-migration/San Francisco Bay north of San Francisco-Oakland Bay Bridge
Chinook salmon *Oncorhynchus tshawytscha* Spring run	T	T	Open water of Delta-nursery, migration; Bay-migration/Under development
Coho salmon *Oncorhynchus kisutch*	E	T	May be found in some tributary streams to the Bay/NA
Steelhead *Oncorhynchus mykiss* Central California Coast ESU	--	T	Open water of Bay in migration, streams along San Francisco and San Pablo Basins/San Francisco Bay west of Golden Gate Bridge
Steelhead *Oncorhynchus mykiss* Central Valley ESU	--	T	Open water of Bay in migration, Sacramento and San Joaquin Rivers and their tributaries
Tidewater goby *Eucyclogobius newberryi*	T	E	Brackish water of lagoons and lower stream reaches/NA
Sacramento splittail *Pogonichthys macrolepidotus*	CSC		Brackish and freshwater sloughs of lagoons of Delta Suisun Marsh, Suisun Bay/NA

Federal Status (determined by USFWS)
E = Federally listed, endangered
T = Federally listed, threatened State Status
CSC = California Species of Special Concern
T = State listed, threatened
E = State listed, endangered

River Lamprey (*Lampetra ayresi*)

River lampreys have been collected from large coastal streams from Alaska to San Francisco Bay (Moyle 2002). They are most abundant in the Sacramento-San Joaquin River systems but also occur in a number of other tributaries to San Francisco Bay. River lampreys are anadromous, but apparently spend only 3 to 4 months in salt water. River lampreys feed on a variety of fishes, most commonly herring and salmon. They typically attach to the back of the host fish where they feed on muscle tissue. The river lamprey is a California Species of Special Concern.

Green Sturgeon (*Acipenser medirostris*)

Green sturgeon are the most marine species of sturgeon, coming into rivers mainly to spawn (Moyle 2002). Juveniles and adults are benthic feeders, and they may also take small fish. Juveniles in the San Francisco estuary feed on opossum shrimp and amphipods. The San Francisco Bay system supports the southernmost reproducing population of green sturgeon (Moyle and Yoshiyama 1992). Indirect evidence indicates that green sturgeon spawn mainly in the Sacramento River. In 2005, NMFS proposed that spawning populations of green sturgeon south of the Eel River be listed as threatened.

Delta Smelt (*Hypomesus transpacificus*)

The Delta smelt is one of the few remaining native species found in the upper reaches of San Francisco Bay and the Delta (Monroe and Kelly 1992). Its range extends from around Isleton on the Sacramento River and Mossdale on the San Joaquin River downstream to Suisun Bay. During periods of high river flow, some individuals are washed into San Pablo Bay, but they do not establish permanent populations there. Delta smelt are considered environmentally sensitive because they only live 1 year, have a limited diet, and reside primarily in the interface between salt and fresh water. The legally defined critical habitat of Delta smelt includes the Delta, Suisun Bay, and Suisun Marsh.

Since 1980, the Delta smelt population has generally declined. Numbers of this species now seem to be critically low. The Delta smelt has been listed as threatened by both the Federal government and the State of California.

After a period of extremely low populations throughout the 1980s, Delta smelt abundance generally increased throughout the 1990's. This increase apparently was in response to an increase in available habitat brought about by a wet winter and spring, which ended a 7-year drought (San Francisco Estuary Project 1997). More recently, however, abundance indices indicate another downward trend, starting in 2001 (San Francisco Estuary Project 2004). The Delta smelt abundance index in 2004 was the lowest ever recorded (Bay Institute 2005b, Bennett 2005). The most likely causes of the decline are freshwater exports, water quality, and invasive species.

Longfin Smelt (*Sprinchus thaleichthys*)

Adult longfin smelt are broadly distributed throughout the Bay, but use the river channels of the Delta for spawning. Longfin smelt have definite seasonal migrations. They spend early summer in Central and San Pablo Bays, move into Suisun Bay in August and, in winter, congregate for spawning at the upper end of Suisun Bay and in the lower reaches of the Delta (Moyle and Yoshiyama 1992). Longfin smelt populations in San Francisco Bay have declined during the last decade. Although longfin smelt are widely distributed in Pacific coast bays and estuaries, only two populations are known from California: (1) in the San Francisco Bay estuary, and (2) in Humboldt Bay and the

Eel River (Moyle and Yoshiyama 1992). Longfin smelt abundance in the San Francisco estuary reached an all-time low in 1992 following 6 years of drought (San Francisco Estuary Project 1997). There is a strong positive relationship between freshwater outflow during the spawning and larval periods and the subsequent abundance of longfin smelt. Moderate outflow in 1993 resulted in a modest population rebound. In 1995, sufficient spawning stock and high outflow led to very good survival and returned the population to predrought abundance levels. Despite reasonably good outflow in 1995-1999 longfin smelt numbers remained fairly low when a stronger upward trend might have been expected (Moyle 2002). Voracious filtering of the base of the food web by the introduced Asian clam and the subsequent decline in the zooplankton prey of longfin smelt is probably a factor in the failure of the smelt population to increase substantially during the 1995 to 1999 wet period (Moyle 2002). Although population levels increased throughout the late 1990s with increased freshwater outflows, the longfin smelt population in San Francisco Estuary is not considered to be fully recovered (Sweetnam et al. 2001). Since the extremely wet winter of 1998, Delta outflow has generally declined and so has the abundance of longfin smelt (San Francisco Estuary Project 2004). The longfin smelt is both a Federal and State species of concern.

Chinook Salmon (*Oncorhynchus tshawytscha*)

After maturing in the ocean, adult Chinook salmon migrate through the San Francisco estuary to spawn in the streambed gravels of the Sacramento River and its tributaries and in the San Joaquin River tributaries (Monroe and Kelly 1992). There are four genetically distinct runs designated by the season in which they enter fresh water to spawn: a fall run that enters fresh water during July through November and begins spawning in October, a late-fall run that moves upstream during October through February and begins spawning in January, a winter run that moves upstream during January through June and begins spawning in April, and a spring run that moves upstream during March through July and begins spawning in August. Although the size of each of the four Chinook salmon runs has fluctuated since the mid-1960s, and although all four runs have declined in the 1980s, the Sacramento River winter run has exhibited the steadiest decline. By 1991, fewer than 200 fish were estimated to return to the river to spawn in this run (Monroe and Kelly 1992). The winter run is considered to be at a critically low level and is listed as endangered under the Endangered Species Act and as endangered under the California Endangered Species Act. The return of 1,361 winter-run fish in 1995 and 900 in 1996 was a significant increase over the 1994 all-time low of 189 fish (San Francisco Estuary Project 1997). Spawning populations between 1998 and 2000 numbered between 1,400 and 3,200 fish indicating some recent recovery (Boydstun et al. 2001). In 2002 and 2003, the Sacramento River winter-run Chinook salmon population showed some continuing recovery from the extremely low numbers of the early 1990's (CDFG 2004). However, the population remains well below draft recovery goals established for the run.

The spring run has also declined markedly since the mid-1980s. The spring run of Chinook salmon is listed as threatened by the State and Federal governments and has been proposed by the Federal government for listing as endangered. Spring-run abundance averaged 13,000 between 1967 and 1991, but recent populations in several Sacramento River tributaries are at low levels (San Francisco Estuary Project 1997). Spawning populations increased during the late 1990's and have remained steady through 2003 (Boydstun et al. 2001, San Francisco Estuary Project 2004).

The Central Valley fall/late fall run Evolutionarily Significant Unit (ESU) remains the most abundant and ubiquitous Chinook stock, and the 1996 return of 212,000 was a significant increase over the previous 6 years (San Francisco Estuary Project 1997). San Joaquin fall-run Chinook returns in 1996 remained far below the 1967-1991 average return of 21,000. Central Valley fall/late fall run abundance increased significantly between 1996 and 2000 and remained steady through 2003 (Boydstun et al. 2001, San Francisco Estuary Project 2004).

Coho Salmon (*Oncorhynchus kisutch*)

Coho salmon are widely distributed in streams along the Northern and Central California coast (Moyle and Yoshiyama 1992). In California, principal populations are found in the Klamath, Trinity, Mad, Noyo, and Eel Rivers, as well as in smaller coastal streams south to Scott Creek and Waddell Creek in Santa Cruz County. Currently, there are probably less than 5,000 wild Coho salmon spawning in California each year, and many populations have fewer than 100 individuals. The decline in Coho salmon is probably related to a number of factors, including the degradation of coastal streams, the catastrophic effects of floods and drought on an already declining population, the introgression of genetic integrity by planting of hatchery fish, introduced diseases, and overharvesting. Coho salmon are principally found outside the San Francisco Bay estuary, but small numbers may be found in the San Francisco estuary tributary streams (Herbold et al. 1991). There was a small population using Corte Madera Creek, but it is believed to be gone now (Moyle 2002). A 1994 – 1997 survey of native fishes in streams of the San Francisco estuary did not collect any Coho salmon (San Francisco Estuary Project 1997). A more recent assessment of salmonids in Bay tributary streams concluded that Coho salmon are extirpated from the region (San Francisco Estuary Project 2004).

Steelhead (*Oncorhynchus mykiss*) – Central California Coast ESU, Central Valley ESU

Steelhead are anadromous rainbow trout, hatching in fresh water, descending to the sea, and returning to fresh water to spawn. The Central California Coast ESU was listed as threatened by the Federal government in 1997. This ESU includes coastal basins from the Russian River south to Soquel Creek, and streams of the San Francisco and San Pablo Bay Basins. The Central Valley ESU was listed as threatened by the Federal government in 1998. This ESU includes steelhead that spawn in the Sacramento and San Joaquin Rivers and their tributaries.

Currently, small steelhead runs occur in the South Bay in San Francisquito Creek, Steven's Creek, the Guadalupe River, Coyote Creek, and Permanente Creek; in the

East Bay, possibly in Alameda and San Lorenzo Creeks; in the Central Bay in Corte Madera, Miller, Arroya Corte Madera Del Presidio, and Novato Creeks; and in the North Bay in the Petaluma River, Sonoma Creek, and the Napa River drainage (San Francisco Estuary Project 1997). Steelhead may still occur in Wildcat Creek and the Pinole River in southeast San Pablo Bay. Tributaries to Suisun Bay that support steelhead runs include the Sacramento and San Joaquin Rivers, and Green Valley, and Suisun and Walnut Creeks. Steelhead adults and juveniles may be found foraging in and migrating through estuarine subtidal and riverine tidal habitats within all areas of the San Francisco estuary.

Tidewater Goby (*Eucyclogobius newberryi*)

The tidewater goby is endemic to California and lives in the brackish water habitats from Southern California to the Smith River, Del Norte County (Moyle et al. 1989). This species is found in shallow lagoons and lower stream reaches where the water is brackish (salinities usually less than 10 ppt) to fresh. In the past, tidewater gobies were distributed in brackish water habitats around Central Bay and San Pablo Bay. However, in San Francisco Bay and associated streams, at least 9 out of 10 previously identified populations have disappeared, and a 1984 survey of streams of the Bay drainages did not record any populations (Moyle et al. 1989). A 1994 to 1997 survey of San Francisco estuary streams also failed to record any tidewater gobies (San Francisco Estuary Project 1997). The tidewater goby is listed by California as a threatened species and by the Federal government as endangered.

Sacramento Splittail (*Pogonichthys macrolepidotus*)

The Sacramento splittail is a California Central Valley endemic and was once distributed in lakes and rivers throughout the Central Valley (Moyle et al. 1989). Splittail are now largely confined to the Delta, Suisun Bay, Suisun Marsh, Napa Marsh, the lower Petaluma River, and other parts of the Sacramento-San Joaquin estuary (Moyle 2002). Suisun Marsh has a particularly high concentration of splittail. Splittail are primarily freshwater fish but they can tolerate moderate salinities and can live in water with salinities as high as 10 to 12 ppt. The abundance of this species in the Delta system is strongly tied to outflows because spawning occurs over flooded vegetation. About a month of flooding during the spring spawning period is necessary for incubation, growth, and successful larval emigration from floodplains. When outflows are high, reproductive success is high; when outflows are low, reproduction may fail. Splittail abundance in the San Francisco estuary was poor through most of the drought but improved substantially in 1995 and again in 1998 when good outflow conditions led to very large year classes (Moyle 2002). Young-of-the-year abundance was low in 2002 and 2003 probably as a result of low river flow during the splittail spawning period in late February through May (San Francisco Estuary Project 2004). The Sacramento splittail is a California Species of Special Concern. The USFWS removed the splittail from the list of threatened species in 2003.

Sensitive Birds, Mammals, Reptiles, and Amphibians

There are 38 listed species of birds, 6 species of mammals, and 5 species of amphibians or reptiles that occur or have occurred in habitats vulnerable to oil spills (Table 4.3-6). Oil spills or other impacts would be most damaging to these species because they already have small or isolated populations persisting in an altered

Birds

The following species of rare/threatened/endangered birds may be most susceptible to contact by oil spills because of their foraging habits, reliance on intertidal mudflats and tidal saltmarshes for nesting habitat, use of open water, or the known impacts from previous oil spills.

<u>Common Loon *(Gavis immer)*</u>

The common loon's breeding habitat in the western states in limited to Idaho. Winter visitors to San Francisco Bay are found in deeper open water areas.

<u>American White Pelican (*Pelecanus erythrorhynchos*)</u>

The American white pelican is a late summer/fall migrant through the area and a winter visitor. The species nests in large inland lakes in the western states and Canada; only remnant colonies exist in California in the Klamath Basin and Honey Lake area. During fall and winter, white pelicans are locally common in large open water areas, including salt ponds.

<u>California Brown Pelican *(Pelecanus occidentalis californicus)*</u>

The California brown pelican breeds in the spring on islands of the Southern California Bight and Mexico. Following the breeding season, brown pelicans migrate northward. The species reaches its peak abundance in central California in August through September (Briggs et al. 1983). In the Bay, brown pelicans forage over deep open water and roost on many breakwaters and piers and, occasionally, on salt-pond dikes. The 2001 Golden Gate Audubon Society recorded 99 brown pelicans in the Oakland area in its 2001 Christmas bird count (Golden Gate Audubon Society 2002).

Table 4.3-6
Species of Birds, Mammals, Reptiles, and Amphibians of Special Status on Federal and State Lists that Inhabit Open Waters, Rocky Shore, Mudflats, and/or Tidal Marshlands of the San Francisco Bay Estuary

Common Name/Scientific Name	Status*		Habitat/Critical Habitat
	State	Federal	
Birds			
Common loon *Gavis immer*	CSC	--	Open water
American white pelican *Pelecanus erythrorhynchos*	CSC	--	Open water
California brown pelican *Pelecanus occidentalis californicus*	SE	FE	Open water
Double-crested cormorant *Phalacrocorax auritis*	CSC	--	Open water, rocky shore, tidal marshes
Least bittern *Ixobrychus exilis*	CSC	--	Tidal marshes
White-faced ibis *Plegadis chihi*	CSC	--	Tidal brackish/freshwater marshes
Aleutian Canada goose *Branta canadensis kucoparcia*	--	FT	Open water, tidal brackish/ freshwater marshes
Fulvous whistling duck *Dendrocygna bicolor*	CSC	--	Tidal brackish marshes
Barrow's goldeneye *bucephala islandica*	CSC	--	Open water and tidal brackish marshes
Osprey *Pandion haliaetus*	CSC	--	Open water
Northern harrier *Circus cyaneus*	CSC	--	Tidal marshes
Sharp-shinned hawk *Accipiter striatus*	CSC	--	Tidal brackish/freshwater marshes
Cooper's hawk *Accipter cooperii*	CSC	--	Tidal brackish/freshwater marshes
Ferruginous hawk *Buteo regalis*	CSC	--	Tidal brackish/freshwater marshes
Bald eagle *Haliaeetus leucocephalus*	SE	--	Open water, tidal brackish/ freshwater marshes
Golden eagle *Aquila chrysaetos*	CSC	--	Tidal marshes
Merlin *Falco columbarius*	CSC	--	Tidal brackish/freshwater marshes
American peregrine falcon *Falco peregrinus anatum*	SE	--	Tidal marshes
Prairie falcon *Falco mexicanus*	CSC	--	Tidal freshwater marshes
Yellow rail *Coturnicops noveboracensis*	CSC	--	Tidal marshes
California black rail *Laterallus jamaicensis conturniculus*	ST	--	Tidal saltmarshes

Table 4.3-6 (continued)
Species of Birds, Mammals, Reptiles, and Amphibians of Special Status on Federal and State Lists that Inhabit Open Waters, Rocky Shore, Mudflats, and/or Tidal Marshlands of the San Francisco Bay Estuary

Common Name/Scientific Name	Status*		Habitat/Critical Habitat
	State	Federal	
California clapper rail *Rallus longirostris obsoletus*	SE	FE	Tidal saltmarshes
Greater sandhill crane *Grus Canadensis tabida*	ST	--	Tidal brackish/freshwater marshes
Western snowy plover *Charadruis alexandrinus nivosa*	CSC	FT	Intertidal mudflat
Long-billed curlew *Numenius americanus*	CSC	--	Intertidal mud, tidal marshes
California gull *Larus californicus*	CSC	--	Open water, intertidal mud, tidal marshes
Elegant tern *Sterna elegans*	CSC	--	Open water, rocky shore, intertidal mudflat
California least tern *Sterna antillarum browni*	SE	FE	Open water, tidal saltmarshes
Marbled murrelet *Brachyramphus marmoratus*	SE	FE	Open water
Burrowing owl *Athene cunicularia*	CSC	--	Tidal salt/brackish marshes
Long-eared owl *Asio otus*	CSC	--	Tidal marshes/upland grass lords
Short-eared owl *Asio flammeus*	CSC	--	Tidal marshes
Black swift *Cypseloides niger*	CSC	--	Rocky shore
Saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	CSC	--	Tidal saltmarshes
Alameda song sparrow *Melospiza melodia pusillula*	CSC	--	Tidal saltmarshes
Suisun song sparrow *Melospiza melodia maxillaris*	CSC	--	Tidal saltmarshes
San Pablo song sparrow *Melospiza melodia samuelis*	CSC	--	Tidal saltmarshes
Tricolored blackbird *Agelaius tricolor*	CSC	--	Tidal brackish/freshwater marshes
Mammals			
Saltmarsh wandering shrew *Sorex vagran halicoetes*	CSC	--	Tidal marshes
Suisun ornate shrew *Sorex ornatus sinuosus*	CSC	--	Tidal marshes
Saltmarsh harvest mouse *Reithrodontomys raviventris*	SE	FE	Tidal salt/brackish marshes
San Pablo vole *Microtus californicus sanpabloensis*	CSC	--	Tidal brackish marshes
Humpback whale *Megaptera novaeangliae*	--	FE	Open water

Table 4.3-6 (continued)
Species of Birds, Mammals, Reptiles, and Amphibians of Special Status on Federal and State Lists that Inhabit Open Waters, Rocky Shore, Mudflats, and/or Tidal Marshlands of the San Francisco Bay Estuary

Common Name/Scientific Name	Status*		Habitat/Critical Habitat
	State	Federal	
California Amphibians			
Tiger salamander *Ambystoma tigrinum*	CSC	--	Freshwater and brackish marshes
California red-legged frog *Rana aurora draytoni*	CSC	FT	Tidal freshwater marshes
Reptiles			
San Francisco garter snake *Thamnophis sirtalis*	SE	FE	Tidal freshwater marshes
Western pond turtle *Clemmys marmorata*	CSC	--	Tidal freshwater marshes

***Federal Status (determined by USFWS)**
E = Federally listed, endangered
T = Federally listed, threatened

State Status
CSC = California Species of Special Concern
T = State listed, threatened
E = State listed, endangered

Source: Code of Federal Regulations, Title 50, Parts 17.11 and 17.12 (April 15, 1990) and Annual Notices of Review; USFWS Sensitive Bird Species List; USFWS Migratory Nongame Birds of Management Concern List; CDFG Natural Diversity Data Base, Special Animals, 2002.

Double-Crested Cormorant *(Phalacrocorax auritis)*

This species nests in the San Francisco Bay Area, predominantly on bridges, towers, and other man-made structures. The colony breeding on the San Francisco-Oakland Bay Bridge numbered 465 pairs in 1990, making it the second largest in the State. The cormorant population on the Bay Bridge saw a 71 percent increase from 1990-1999 (American Segmental Bridge Institute 2002). The large colony on the Richmond-San Rafael Bridge had 424 breeding pairs in 1990. In 2000, the Richmond-San Rafael Bridge Colony fledged 433 chicks (Rauzon 2000). Recently, the double-crested cormorant colony in San Francisco Bay has declined (Elliott, PRBO, pers. comm. 2005). Based on a June 2005 survey the colony on the Bay Bridge declined 38 percent since 2004 and the colony on the Richmond-San Rafael Bridge declined 23 percent since 2004. The 2005 double-crested cormorant population sizes are comparable to the population sizes recorded in the late 1980’s. Smaller nesting colonies are found at a variety of other sites throughout the Bay (Carter et al. 1992).

California Black Rail *(Laterallus jamaicensis conturniculus)*

The California black rail's habitat of tidal marshes has been greatly reduced and fragmented. The species currently breeds only in San Pablo Bay, Suisun Bay, and the lower Delta. Highest densities of California black rails occur in the Petaluma River Wildlife Management Area, along Black John and Fagan sloughs and Coon Island in the Napa marsh, and in tidal marshes along the shore of San Pablo Bay. This secretive species requires tidal marshes that include higher elevational zones not subject to extreme and frequent tidal action (USFWS 1992). Black rails tend to occur in the larger undiked marshes associated with larger rivers and in some bayshore parcels, particularly those associated with the mouths of rivers and creeks (Nur et al. 1997). Black rail populations in the Bay region have not decreased since 1986 (San Francisco Estuary Project 1997). Black rail surveys in 2001 resulted in population estimates of approximately 15,000 black rails in San Pablo Bay and 12,000 black rails in Suisun Bay (Spautz and Nur 2002). In the 2001 survey, the most rails were heard in San Pablo Bay at Day Island, Black John Slough and nearby Greenpoint Centennial Marsh, Petaluma Marsh and Lower Tubbs Island muted marsh, and in Suisun Bay at Benicia State Park and Rush Ranch. A moderate number of black rails were detected at China Camp, Corte Madera Ecological Marsh, Petaluma Rivermouth, Pond 2A, Fagan Slough, Pt. Pinole, San Pablo Creek Marsh, and in Suisun Bay at Peyton Slough, Hill Slough and Grey Goose. Black rails appear to be absent in Central and South Bays. Point count surveys of birds in 45 marshes in San Francisco Estuary during the 2004 breeding season found the highest density of black rails (0.58 birds per hectare) in Petaluma Marsh in San Pablo Bay (Herzog et al. 2004).

California Clapper Rail *(Rallus longirostris obsoletus)*

The California clapper rail is a year-round resident in the San Francisco Bay area where it continues to suffer severe habitat loss due to human encroachment on tidal marshes and predation by red foxes. Preferred habitat is characterized by close proximity to tidal flow (habitat traversed by tidal sloughs), and cover of pickleweed with extensive stands of Pacific cordgrass at lower elevations and gumplant and wrack at higher elevations. California clapper rails feed on mollusks in mud-bottomed sloughs near cover. The population in the San Francisco Bay Area from 1981-1987 was estimated at only about 1,500 birds (Harvey 1988), but declined to fewer than 500 in 1991 (USFWS 1992). The population has rebounded somewhat to about 1,200 in recent years (San Francisco Estuary Project 1997, CDFG 2002). Based on winter counts from 1996 to 1997, the South Bay population was estimated to be 500 to 600 birds and the North Bay population to be a similar size (CDFG 2000), Central and South Bay clapper rail populations appear to be holding steady but there are indications that North Bay populations are in decline, at least in some areas (San Francisco Estuary Project 2004). Heavy rains in the winter of 1997-1998 may have caused some declines in the North Bay because residual high water particularly along the North San Pablo Bay shore impacted nesting success. Also non-native mammalian predators may be further impacting North Bay clapper rail populations. Distribution of California clapper rail habitat from Gill (1979) is shown on Figure 4.3-2.

Figure 4.3-2

The California least tern was listed as endangered on Federal and State lists in 1970 because of its small population on drastically reduced nesting habitat. In the Bay Area, the species currently has major nesting effort only at Alameda Point (formerly Alameda Naval Air Station). However, peripheral sites also exist where sporadic nesting effort occurs. These sites may be used in 1 year and not the next, but have the potential to become important new colonies (Chambers Group 1994). A PG&E cooling pond in Pittsburg has supported at least two pairs in recent years (San Francisco Estuary Project 1997). In 2004, this colony supported 12 pair (Keane 2004). Least terns previously nested at Oakland Airport but have abandoned the site probably due to predation by feral cats and non-native red foxes (San Francisco Estuary Project 2004).

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In 2004, a total of 391 pair of least terns nested at two sites in the San Francisco Bay area. The largest colony was 379 pair at Alameda Point. An additional 12 pair nested at the Pittsburg power plant. California least terns forage near their colonies in eelgrass beds where they are vulnerable to oil spills.

Western Snowy Plover *(Charadruis alexandrinus nivosa)*

In San Francisco Bay, snowy plovers nest almost exclusively on levees and islands of salt ponds and in dry salt ponds of the south Bay (Warriner et al. 1986). A survey in June 1978 resulted in a count of 351 adult birds, but subsequent June counts have been lower (Page and Stenzel 1981; USFWS 1992). Almost all snowy plover nesting occurs in the South Bay. Breeding season surveys in 2004, counted approximately 113 plovers using the salt ponds and 50 nests were found (San Francisco estuary Project 2004). The winter population of snowy plovers numbers at least 350 birds, most of which are found in the vicinity of salt ponds in the Baumberg area of the South Bay (Page et al. 1986). At any time of year, snowy plovers foraging on intertidal mudflats are vulnerable to impacts of oil spills reaching the South Bay.

Long-Billed Curlew *(Numenius americanus)*

Long-billed curlews are a wintering shorebird in California and do not breed in the San Francisco Bay Area. They are most abundant in the fall and winter and their numbers decline in the spring when they are on their northern breeding grounds.

American Peregrine Falcon *(Falco peregrinus anatum)*

Peregrine falcons in the San Francisco Bay and Delta prey to some extent on terns, shorebirds, and seabirds. In this part of their range, they forage predominantly in wetlands surrounding the Bay. Because of the possibility of ingestion of oil-contaminated prey or scavenged carcasses, the peregrine falcon and other raptors are at risk of oil spills.

Mammals

Suisun Ornate Shrew *(Sorex ornatus sinuosus)*

The Suisun shrew is an inhabitant of tidal marshes of northern San Pablo and Suisun Bays and, historically, ranged as far east as Grizzly Island and as far west as the mouth of Sonoma Creek, the Petaluma River, and Tubbs Island (Western Ecological Services Company 1986b, as cited in USFWS 1992). The species currently may be found only on Grizzly Island (Williams 1983). Suisun shrews inhabit the middle-to-high marsh elevations where deposited litter and driftwood provide shelter and forage. An important adjunct of habitat is that higher upland areas exist where animals can move during extreme high tides. While some tidal marshes in San Pablo Bay exist with access to higher marshland vegetation, most are broken into small, isolated units with little elevational gradient. Diked marshes may provide suitable cover for these shrews and are more available in Suisun Marsh than elsewhere (Western Ecological Services Company 1986b, cited in USFWS 1992). The CNDDB lists occurrences at Lake Chabot, Sears Point Road northwest of Vallejo, Southampton Bay in Solano County, Suisun City saltmarsh, near Cordelia salt marsh, near Napa River and Highway 37, near White Slough and Highway 37, South and Dutchmans Sloughs, and at Mare Island Naval Shipyard at the mouth of Carquinez Strait (CDFG2002).

Saltmarsh Wandering Shrew *(Sorex vagran halicoetes)*

This species prefers tidal salt marshes with dense cover of pickleweed and sufficient driftwood to provide soil moisture adequate for habitat and invertebrate food resources. It is apparently limited to the southern San Francisco Bay where it inhabits marshes 2 to 3 m above the high water line (Findley 1955). For the purposes of this EIR, the current distribution is defined by past records of observations and captures, including marshes of Santa Clara, Alameda, Contra Costa, San Mateo, and San Francisco Counties (Williams 1986). The CNDDB lists occurrences in the saltmarsh at the west approach to the Dumbarton Bridge, on Bair Island near Redwood Point, in Alameda Creek, at Giant Marsh in Contra Costa County, in San Pablo Creek saltmarsh north of Richmond, at Arrowhead (Melrose) Marsh north of Oakland Airport, at Oakland Airport, at Ravenswood Point in San Mateo County, and at Johnson and Hayward Landings in Alameda County.

<u>Saltmarsh Harvest Mouse *(Reithrodontomys raviventris)*</u>

The saltmarsh harvest mouse is endemic to salt and brackish marshes where its preferred habitat is the higher tidal wetlands that provide access, if necessary, to refugia during extreme high tides (USFWS 1992). The preferred habitat is typically dominated by pickleweed, along with a diverse mixture of vegetation characterizing the transition zone. Saltmarsh harvest mice are also able to use diked marshes and adjacent grasslands during the late spring. Two subspecies exist in the area: the northern, inhabiting San Pablo and Suisun Bays, and the southern, inhabiting central and southern San Francisco Bay. Currently, suitable habitat is only about 5 percent of that historically available, and conservation of the species focuses on habitat protection and restoration. It is not known whether the population in San Francisco Estuary has changed significantly in recent years (San Francisco Estuary Project 2004). The CNDDB lists occurrences at many sites in saline emergent wetlands of Solano, Contra Costa, Alameda, San Mateo, Marin, Sonoma, and Napa Counties.

<u>San Pablo Vole *(Microtus californicus sanpabloensis)*</u>

San Pablo vole populations are found in three widely isolated fragments in saltmarshes along the south shore of San Pablo Bay in Contra Costa County (Western Ecological Services Company 1986c, cited in USFWS 1992). The CNDDB indicates occurrences in Giant Marsh and adjacent grasslands, San Pablo Creek and associated saltmarsh, and Wildcat Creek and marsh at creek mouth (CDFG 2002).

<u>Humpback Whale *(Megaptera novaeangliae)*</u>

The humpback whale is a federally listed endangered species that feeds in the Gulf of the Farallones in the fall. One individual entered San Francisco Bay in October 1985 and again in October 1990 (“Humphrey”). Sightings of individual whales have been made regularly near the mouth of the Bay (Chambers Group 1994).

Amphibians and Reptiles

The amphibian and reptile fauna of the brackish and freshwater marshes in the San Francisco Bay region includes five species that are listed as rare/threatened/ endangered (or candidate) or California Species of Special Concern (Table 4.3-6). While all may use tidal marshes as habitat, they are not limited to marshes nor are they necessarily present wherever that habitat-type occurs. Because of their rarity, distributional data are limited.

California Tiger Salamander *(Ambystoma tigrinum)*

This species may typically be out of reach of oil spills; found in some brackish freshwater marshes, it more commonly occurs at higher elevations. For survival, it requires vernal pools for breeding and access to rodent burrows for hibernation and estivation (dormant period during the summer) (citations in USFWS 1992). The CNDDB lists its present range to include San Francisquito Creek in San Mateo County.

California Red-Legged Frog *(Rana aurora draytoni)*

The California red-legged frog is rare in the San Francisco Bay region, and has only a few relict populations in surrounding coastal mountains and the Delta. It prefers fresh and brackish marshes and riparian habitats. In the San Francisco Bay region, red-legged frogs are present in the Santa Cruz Mountains, the San Francisco State Fish and Game Refuge in San Mateo County, in canals at the San Francisco International Airport, and in northern Contra Costa County at the Concord Naval Weapons Station, Marsh and Kellogg Creeks, and in the Los Vaqueros area (citations in USFWS 1992). The CDFG Natural Diversity Database also indicates occurrence in Golden Gate Park, the Presidio, and other sites near the city of San Francisco. The USFWS established critical habitat for the red-legged frog in 2001 but was forced to rescind the rule by a lawsuit. In 2004, the USFWS re-proposed critical habitat for the California red-legged frog (Krofta 2004). The re-proposed critical habitat included areas in the San Francisco Bay watershed. A final revised rule is expected in late 2005.

San Francisco Garter Snake *(Thamnophis sirtalis)*

The San Francisco subspecies of the common garter snake is listed as endangered (by both the Federal and State alternatives). It is known to occur in tidal, (brackish) freshwater marshes but may be more common at higher elevations. It has been recorded in recent years in the San Francisco State Fish and Game Refuge (San Mateo County), near Crystal Springs Reservoir, Sharp Park Golf Course in Pacifica, Mori Point, Cascade Ranch, Sanchez Canyon in Hillsborough, San Francisco International Airport, and in irrigation ponds along the San Mateo coast (USFWS 1992, CDFG 2002).

Western Pond Turtle (*Clemmys marmorata)*

Habitat requirements of the western pond turtle include backwater areas with abundant vegetation, logs for basking, and open sunny slopes well away from riparian zones for egg deposition (USFWS 1992).

4.3.1.2 Project Area

Introduction

This section describes in detail the tidally influenced biological resources of the study area. The study area includes the area between Golden Gate Bridge, Bay Bridge, and

Carquinez Bridge (San Pablo Bay and Central Bay). The biological resources subject to tidal inundation within this area would be more vulnerable to an oil spill from operations at the Long Wharf than resources located elsewhere in the estuary.

Study Area Resources

Plankton

The phytoplankton community in Central Bay is similar to that in the open ocean (Cloern 1979). Peak phytoplankton growth occurs from March to June as it does in coastal waters (Davis 1982). The assemblage is dominated by typical coastal forms such as *Chaetoceros* spp., *Nitzschia* spp., *Rhizosolenia* spp. and *Skeletonema costatum* (Cloern 1979). It is likely that the spring bloom in Central Bay results from the dispersion of planktonic diatoms into San Francisco Bay from offshore blooms during the upwelling season. Phytoplankton levels increased in Central Bay in 2004 (Bay Institute 2005a).

A bloom of phytoplankton also typically occurs in San Pablo Bay in spring (Cloern 1979). Part of this bloom is related to the dispersion of marine phytoplankton into San Pablo Bay, but densities are typically higher than in Central Bay. Cloern (1979) suggested that as marine phytoplankton enter San Pablo Bay, they become entrained in the entrapment zone and are dispersed laterally into the warm, shallow waters of San Pablo Bay where light levels are high and rapid growth occurs. The diatoms, *Thalassiosira* spp. and *Skeletonema costatum*, often are the major bloom taxa (Herbold et al. 1992). Phytoplankton abundance was stable in San Pablo Bay in 2004 (Bay Institute 2005a).

Zooplankton populations in Central Bay are largely dominated by influxes from ocean and South Bay waters (USACE, EPA, BCDC, SFBRWQCB, and SWRCB 1998). The copepod *Acartia clausi* is typically the most abundant species. In San Pablo Bay, this coastal species is found with zooplankton species characteristic of brackish waters (Painter 1966). Overall, *Acartia clausi* and the brackish water *Eurytemora affinis*have been found to be the most abundant species in the channels and shallow flat areas of San Pablo Bay. *Acartia clausi* tends to dominate zooplankton assemblages in San Pablo Bay in the dry season, and *Eurytemora affinis* dominates in the wet season (Herbold et al. 1992).

Benthos

Most of the natural rocky shore habitat in the San Francisco estuary is found in the Central Bay and the southern margin of San Pablo Bay. Natural rocky shore habitat occurs at Yerba Buena Island, Angel Island, Alcatraz Island, Red Rock, and the Brothers, and along the shoreline of Tiburon Peninsula, Belvedere, Dumbuton Narrows, San Pablo Point, and the north and south sides of the Golden Gate Bridge. Most of the species found in these rocky areas are typical of rocky shoreline habitats on the outer coast. However, the Bay mussel, *Mytilus galloprovincialis*, rather than the open coast

California mussel, *M. californianus*, is typical of rocky habitats within the Bay. Manmade substrate is populated by many of the same species as natural rock, but the marine communities tend to be less diverse on man-made structures.

Macroalgae are most commonly found growing in hard bottom areas (rock outcrops, coarse sediments, and manmade structures) of Central and San Pablo Bays. The richest localities are Fort Point, Lime Point, Point Cavallo, and Point Blunt on Angel Island (Silva 1979). The macroalgae flora of the Bay consists both of endemic cool temperate Pacific Coast species and of species with wide distribution (Silva 1979).

Muddy sediments in Central Bay contain the most diverse of the soft bottom assemblages in the San Francisco Estuary (Thompson et al. 1999). The Benthic Pilot Study of the San Francisco Estuary Institute reported that dominant species found in the Central Bay muddy sediment assemblage in recent surveys were dominated by three species of amphipod *Corophium acherusicum, Ampelisca abdita,* and *Corophium heteroceratum* (Thompson et al. 1999). Benthic surveys conducted in nearshore areas off Point Molate in 1996 for the proposed John F. Baldwin Navigation Channel project also reported a high number of species and large numbers of *Ampelisca abdita*, but the Asian clam *Potamocorbula amurensis* was very abundant (USACE and Contra Costa County 1997). Sandy sediments in the Central Bay in the vicinity of Red Rock contained a much lower diversity and abundance of benthic organisms than muddy substrate (Thompson et al. 1999). The most abundant taxa in sandy sediments were the polychaete worm *Heteropodarke heteromorpha* and nematode worms (Thompson et al. 1999). Intertidal mudflats in Central Bay support a variety of clams including *Macoma* spp., soft-shell clams (*Mya arenaria*), and bay shrimp (*Crangon nigricauda* and *C. nigromaculata*) (USACE and Contra Costa County 1997).

Benthic communities in San Pablo Bay are typically less diverse than those of Central Bay (Thompson et al. 1999). San Pablo Bay sediments generally support an estuarine assemblage dominated by the Asian clam *Potamocorbula amurensis* and the amphipod *Ampelisca abdita* (Thompson et al. 1999).

Common epibenthic invertebrates in both Central Bay and San Pablo Bay include grass shrimp (*Crangon franciscorum, C. nigricauda, C. nigromaculata*), oriental shrimp (*Paleamon macrodactylus*), and broken-back shrimp (*Heptacarpus* sp.), as well as Dungeness crab (*Cancer magister*) and shore crabs (*Hemigrapsus nudus* and *H. oregonensis*) (Keegan et al. 1989; USACE and Contra Costa County 1997; Jefferson Associates 1987). San Pablo Bay supports the highest numbers of juvenile Dungeness crabs within the estuary.

Eelgrass (*Zostera marina*) in the San Francisco estuary occurs from the central part of South Bay, along a number of shoreline areas in Central Bay, into the south end of San Pablo Bay (Merkel 2004). The largest eelgrass bed in the estuary (1,504.5 acres) occurs in San Pablo Bay off Point San Pablo. An additional 308.4 acres of eelgrass was mapped in 2003 in the vicinity of the Long Wharf between Point Orient and the Richmond Breakwater (Merkel 2004).

Eelgrass along the San Pablo Peninsula and Point Molate was surveyed in 1996 (USACE and Contra Costa County 1997). The eelgrass in all places surveyed was present in aggregations of patches, ranging from individual shoots to groups as large as 1.8 to 2.4 meters (6 to 8 feet) in diameter. Bottom coverage was less than 20 percent. Densities were between 13.2 and 75.2 shoots per square meter in San Pablo Bay, 21.2 to 62 shoots per square meter at Point Orient, and 44 to 122 shoots per square meter at Point Molate. During the surveys, divers observed salmonids and harbor seals in the Point Molate cove beds, sturgeon near the Point San Pablo bed, and brown pelicans near all the beds.

Eelgrass depends on relatively high light levels for optimal growth. The waters of San Francisco Bay are typically turbid and the euphotic zone is limited to the upper 2 m of the water column. Consequently, eelgrass is limited to depths of less than 1.5 meters (5 feet) in most parts of the Bay (Zimmerman et al. 1995).

Fishes

This section describes the characteristics of the fish assemblages in Central and San Pablo Bays. Important non-listed fish species of the project region are then discussed in greater detail. Listed fish species were discussed above under Sensitive Fishes and shown in Table 4.3-5.

Characteristics of the Project Region

Central Bay is characterized by a rich assortment of fish species including components from the open ocean, the lagoon-like environment of South Bay, and the more freshwater-influenced San Pablo Bay. The most abundant species are northern anchovy, shiner perch, Pacific herring, and jacksmelt (Table 4.3-7). Anadromous species, including Chinook salmon, striped bass, and American shad, pass through on a seasonal basis. Chinook salmon are present primarily between April and June, with irregular occurrences between July and September (Herbold et al. 1992). They are rare in Central Bay between September and April. Pacific herring, which occur in other portions of the Bay, mostly spawn in Central Bay around Tiburon and Angel Island.

Herring spawning areas are shown in Figure 4.3-3. Young-of-the-year English sole in San Francisco Bay are most abundant in Central Bay. Speckled sanddab are also more abundant in Central Bay than elsewhere in the estuary (Herbold et al. 1992). The California and Pacific halibuts are both important bottom fishes in the Central Bay, Golden Gate Bridge area. In general, the fishes found in Central Bay are similar to those of San Pablo Bay near the entrance to that embayment and are similar to the open ocean near the Golden Gate. Longfin smelt, for example, are most abundant in the northern part of Central Bay.

Figure 4.3-3 – Pacific Herring

Table 4.3-7
Comparison of Dominant Fishes Caught in Otter and Midwater Trawls in the Project Region

Species	Rank in Total Midwater Catch	Rank in Otter Trawl*
Central Bay		
Northern anchovy	1 (393)	2 (336)
Pacific herring	2 (335)	
Jacksmelt	3 (211)	
Longfin smelt	4 (154)	6 (311)
Shiner perch	5 (134)	1 (358)
White croaker	6 (113)	4 (331)
Speckled sanddab		5 (313)
English sole		3 (336)
San Pablo Bay		
Northern anchovy	1 (539)	2 (398)
Longfin smelt	2 (335)	1 (417)
Jacksmelt	3 (302)	
Pacific herring	4 (300)	
Striped bass	5 (207)	6 (293)
American shad	6 (155)	
Starry flounder		5 (313)
Shiner perch		4 (321)
Yellowfin goby		3 (336)

*** An otter trawl is a net dragged along the bottom to catch bottom fish.**
Source: Herbold, Jassby, and Moyle 1992.

Much of Central Bay is deep, but significant shallow water fish habitat is found on the eastern side near the Long Wharf Long Wharf. Fish populations in these shallow areas vary seasonally more than in the deeper channels. Starry flounders are characteristic of the shallows but not the deeper areas (Herbold et al.1992).

San Pablo Bay provides extensive shallow water habitat. The fishes of San Pablo Bay consist of resident estuarine species including longfin smelt, starry flounder, striped bass, and staghorn sculpin, and marine species such as white croaker, bay goby, jacksmelt, and shiner perch, which invade in dry years or during the spring and summer months. San Pablo Bay is also used as a nursery ground for English sole and Pacific herring. Anadromous species such as Chinook salmon and American shad pass through during their migrations. American shad are usually found in the shallow water of the north side of the embayment, while salmon are usually found on the channel side. The main feature affecting fish distribution within San Pablo Bay seems to be distance from the Golden Gate (Herbold et al. 1992). Fish assemblages become more estuarine upstream and oceanic species become less common. Most of the characteristic species of San Pablo Bay, especially sturgeon, striped bass, and longfin smelt, have severely declined in recent years.

Important Fish Species of the Project Area (see previous section for Sensitive Species)

Striped Bass (*Morone saxafilis*)

The striped bass was introduced in 1879 and was successful enough to support a commercial fishery until 1935, when commercial fishing was banned. The striped bass spawns in the Sacramento-San Joaquin Rivers at salinities of 0 to 0.5 ppt. At salinities greater than 1 ppt, egg survival declines significantly (Jefferson Assoc. 1987). After spawning, the adults move back downstream to the Bay and ocean where they remain until the following breeding season. Juvenile striped bass migrate downstream to the Delta and the Bay where they remain during their first year. Young fish rearing habitat extends into San Pablo Bay during wet years (CALFED Bay-Delta Program 1998).

The striped bass population has declined significantly in recent years. Hydrological changes in the Delta seem to be the primary cause of this decline (Herbold et al. 1991), but there may be other factors, such as the accumulation of toxic contaminants and reduction of the larval food supply. In 1996, some of the lowest abundances ever recorded in regular surveys were reported (San Francisco Estuary Project 1997). These low catches were especially unusual because 1996 was a wet year. Other theories for the decline in striped bass include young fish entrainment at water export pumps in the Delta, greater migration of adult bass out to sea in El Nino storm years, and reduced “carrying capacity” of the system. Population estimates for legal-sized fish were about 1.8 million in the early 1970s and 0.8 million by the late 1990s. Striped bass populations increased to about 1.3 million in 1998 (Stevens and Kohlhorst 2001). The increased abundance in the late 1990s is unexplained, but may be due to factors allowing greater survival of young fish. Although adult striped bass numbers have increased, the abundance of young-of-the-year striped bass remains at very low levels (San Francisco Estuary Project 2004). In general, for most of the last decade, striped bass population abundance has been relatively stable at levels significantly lower than the average abundance measured between 1980 and 1984 (Bay Institute 2004).

American Shad (*Alosa sapidissima*)

American shad populations in San Francisco Bay rapidly increased following its introduction in 1871. American shad spend most of their adult lives in the ocean, except for a brief spawning run into fresh water. Most of the shad in the area around San Francisco Bay spawn in the Sacramento River or its tributaries. Spawning migrations begin in March and peak spawning occurs in late May or June. Most of the young migrate downstream rapidly after hatching. By December, most are gone, but a few remain as long as a year. Many adults die after spawning, but some return to the ocean and spawn again in later years. American shad spawn least successfully in dry years.

White Sturgeon (*Acipenser transmontanus*)

Two species of sturgeon inhabit the San Francisco estuary-Delta system, the white sturgeon and the green sturgeon. The white sturgeon is much more abundant in San Francisco estuary than the green sturgeon, partly because green sturgeon spend a greater portion of their lives in the ocean. White sturgeon spend most of their lives in estuaries (Moyle 2002). Recruitment of white sturgeon appears to be greatest in years of high outflow. White sturgeon in San Francisco Estuary were nearly decimated by overfishing but have been restored through proper management of the fishery (Moyle 2002).

Northern Anchovy (*Ergraulis mordax*)

The northern anchovy is the most abundant fish in San Francisco Bay. Northern anchovy are seasonally present in San Francisco Bay. They tend to enter the Bay in April of most years and migrate out to the ocean in the fall. In San Pablo Bay, anchovy abundance peaks later and drops more rapidly than in Central Bay. Most of the population spawns in the ocean, but spawning within the Bay has also been reported. Larval anchovies begin to appear in the Bay early in the spawning season of February through June. Northern anchovy show large fluctuations in numbers in response to both marine and estuarine conditions, but there are no obvious trends in recent years.

Pacific Herring (*Clupea harengeus*)

Pacific herring enter San Francisco Bay in late fall and winter to spawn and then return to the ocean. Most of the spawning in San Francisco Bay occurs in intertidal and shallow habitats of the central Bay and northern south Bay. Smaller young tend to be widely distributed in shallower habitats in South, Central, and San Pablo Bays. As they grow, they move to deeper waters closer to the Golden Gate. Most young Pacific herring emigrate from the Bay between April and August. Since 1974, there has been a trend toward increasing biomass of spawning herring. The spawning biomass of Pacific herring was the third highest on record in 1996 and 1997 at 89,000 tons (San Francisco Estuary Project 1997). The previous year produced the second-highest biomass on record at 99,000 tons. However 1998 yielded the lowest year on record. The lowest biomass estimates have occurred during or just after El Nino events (Watters et al. 2001). San Francisco Bay's population has not yet recovered from the effects of the 1997-1998 El Nino. Spawning biomass was estimated at 34,400 short tons for 2003-2004 (San Francisco Estuary Project 2004).

Tidal Marshes

Figure 4.3-4 shows tidal marshes in the San Francisco Bay estuary. Table 4.3-8 lists the major tidal marshes of Central and San Pablo Bays.

Figure 4.3-4 – Tidal Marshes

Table 4.3-8
Major Tidal Marshes of Central and San Pablo Bays*

Name/County	Marsh Type	USGS 7.5' Quad
Richardson Bay/Marin	Salt/tidal flat	San Francisco North
Muzzi Marsh/Marin	Salt	San Rafael
Corte Madera Ecological Reserve/Marin	Salt	San Rafael
Corte Madera Creek/Marin	Salt	San Quentin
China Camp State Park/Marin	Salt	Petaluma Point
Gallinas Creek south/Marin	Salt	Petaluma Point
Gallinas Creek north/Marin	Salt	Petaluma Point
West San Pablo Bay/Marin	Salt	Petaluma Point
Novato Creek/Marin	Salt/slough	Petaluma Point
Black John Slough/Marin	Salt/slough	Petaluma River
Petaluma River/Marin, Sonoma	Salt	Petaluma River
Petaluma Marsh Wildlife Area/Sonoma	Salt/brackish	Petaluma River
Petaluma Marsh north/Sonoma	Salt/brackish	Petaluma River
Midshipman Point/Sonoma	Salt	Petaluma Point, Sears Point
North San Pablo Bay/Sonoma	Salt	Sears Point
North San Pablo Sloughs and Creeks/ Sonoma, Napa	Brackish	Sears Point, Mare Island, Cuttings Wharf
San Pablo and Wildcat Creeks/Contra Costa	Salt	San Quentin
Hoffman Marsh/Contra Costa	Salt	Richmond
Emeryville Crescent/Alameda	Salt	Oakland West
***Adapted from Joselyn 1983.**		

Although much of the Central Bay shoreline consists of various types of natural and manmade hard substrate, several significant tidal marshes exist along the shoreline. Major marsh systems on the west side of Central Bay include the Richardson Bay marshes, the Corte Madera marshes, and San Rafael Creek marsh. The Corte Madera and San Rafael Creek marshes are inhabited by several sensitive species, including saltmarsh harvest mouse and California clapper rail. On the southeast side of Central Bay, major marsh systems include Hoffman Marsh and Emeryville Lagoon, both of which support California clapper rail.

San Pablo Bay is ringed with extensive tidal marsh systems. The San Pablo Bay marshes support California clapper rail, saltmarsh harvest mouse, California black rail, and rare plants including soft bird's-beak, Suisun aster, and Marin knotweed.

Avifauna

Waterbirds and seabirds that nest in colonies in the project region include western gulls, black oystercatchers, black-crowned night-herons, and pigeon guillemots, as well as cormorants and terns. Table 4.3-9 lists the location of seabird nesting colonies in Central and San Pablo Bays.

Table 4.3-9
Seabird Colonies of Central Bay and San Pablo Bay

Species	Nesting Location
Western Gull	Yellow Bluff, CB Sausalito Point, CB
	Peninsula Pt./Cone Rock, CB
	Angel Island, CB
	Bluff Pt. to Paradise Cay, CB
	Point San Quentin, CB
	Marin Islands, CB
	Alcatraz Island, CB
	Pier 45, CB
	San Francisco Piers, CB
	Treasure Island, CB
	Yerba Buena Is., CB
	The Brothers, CB
	Castro Pt., CB
	Richmond-San Rafael Bridge, CB
	Red Rock, CB
	Long Wharf, CB
	Richmond Harbor Entrance, CB
	Brooks Island, CB
	Richmond Inner Harbor, CB
	The Sisters/Pt. San Pedro, SPB
	Rat Rock, SPB
	West San Pablo Bay Ship Channel, SPB
	San Pablo Bay Duck Blinds, SPB
	Davis Pt. Unocal Wharves, SPB
	Hercules Wharf, SPB
	Pinole Pt., SPB
	East San Pablo Bay Ship Channel, SPB
Black Oystercatcher	Marin Islands, CB Yerba Buena Island, CB The Brothers, CB Alcatraz Is. CB Brooks Island, CB
Double-Crested Cormorant	Richmond-San Rafael Bridge, CB Bay Bridge, CB Russ Island, SPB
Forsters Tern	Island # 2, SPB
Caspian Tern	Brooks Island, CB
Brandt's Cormorant	Yerba Buena Island, CB Alcatraz Island, CB
Pelagic Cormorant	Yerba Buena Island, CB The Needles, CB Alcatraz Island, CB
Black-Crowned Night-Heron	West Marin Island, CB Red Rock, CB Brooks Island, CB Alcatraz Island, CB
Pigeon Guillemot	Alcatraz Island, CB

CB = Central Bay
SPB = San Pablo Bay.
Source: Carter 1992; Thayer et al. 1998; Chambers Group 1994.

The western gull is the most widely distributed nesting seabird in the project region. Alcatraz Island supports the largest colony within the project region. Tern colonies in the project region include a Forster's tern colony on Island No. 2 in San Pablo Bay and a Caspian tern colony on Brooks Island in Central Bay.

Black-crowned night-herons are common in the Bay Area; however, they are difficult to census and their distribution is not completely known. Approximately 70 percent of the San Francisco Bay night-heron population nests in or near the North Bay.

Double-crested cormorants have large populations on or near the cross-Bay bridges, including the Richmond-San Rafael Bridge near the Long Wharf. These colonies grew throughout the 1990's but declined in 2005 (Elliott, PRBO, pers. comm. 2005). Brandt's cormorants in the Bay are primarily transients and winter residents, but colonies have become established on Alcatraz Island and Yerba Buena Island. Brandt's cormorant nests on Alcatraz Island declined from 215 in 1997 to 124 in 1998, probably as a result of the effects of the 1998 El Nino on food resources (Thayer et al. 1998). Pelagic cormorants breed on Alcatraz Island, the Needles near the Golden Gate Bridge, and on Yerba Buena Island. As was true of Brandt's cormorants, nesting by pelagic cormorants on Alcatraz Island declined in 1998 compared to 1997. Recently the Brandt's cormorant colony on Alcatraz Island has been increasing with over 700 nests in 2004, but the pelagic cormorant population remains low with only 13 pair in 2004 (PRBO 2004).

In addition to the species that nest on islands and structures in Central Bay and San Pablo Bay and on the immediate shoreline of those embayments, a number of species nest in the vegetated tidal marshes within the project area. The tidal marshes of San Francisco Bay support two listed species of rails – the California black rail (state threatened) and the California clapper rail (federal and State endangered). The major marshes of both Central Bay and San Pablo Bay support clapper rails. Black rails occur in San Pablo Bay marshes but not Central Bay (San Francisco Estuary Project 1997). Yellow rails, Virginia rails, and sora also occur, especially in brackish and freshwater marshes. Great blue herons are relatively common in low-salinity salt ponds. Their distribution is not completely known, but includes sites in most tidal marshes where trees or brush occur for nesting.

The open waters of the project region support large numbers of wintering waterfowl. The greatest number of waterfowl is found in west and north San Pablo Bay, which has been documented to contain approximately 30 percent of the waterfowl in the San Francisco estuary (Chambers Group 1994). Scaup and scoters account for 90 percent or more of the waterfowl in the open water of Central Bay and San Pablo Bay, while canvasbacks and ruddy ducks are the most abundant waterfowl species in salt ponds of San Pablo Bay. Red-throated, Pacific, and common loon are found predominantly in deeper open waters of Central Bay. Western and Clark's grebes are also common winter visitors that are most abundant in Central Bay near narrows and islands. Horned grebes are winter visitors found primarily in open tidal parts of Central and San Pablo Bays.

A large winter and spring population of shorebirds uses the San Francisco estuary. The San Francisco estuary is recognized as a staging/wintering area of hemispheric importance to shorebirds (Hui et al. 2001). Only a few species of shorebird nest locally. Mudflats are the primary foraging grounds for shorebirds, although a few species forage on rocky shores. The largest shorebird numbers are in the south Bay. The winter shorebird population in San Pablo Bay accounts for 26 percent of the total winter shorebird population in San Francisco Bay. Only 2 to 3 percent occur in Central Bay.

Marine Mammals

Harbor seals use San Francisco Bay for foraging, resting, and breeding. Harbor seal numbers on land increase through the spring as the 2 - to 3-month breeding season gets underway. Numbers at each haul-out site vary widely depending on date, time of day, tide, and degree of disturbance. The site on Tubbs Island in San Pablo Bay is the farthest from the outer coast; however, this site is not consistently occupied. San Francisco Bay harbor seal numbers have remained fairly stable over the past decade (San Francisco Estuary Project 2004).

Harbor seals haul out in substantial numbers on Castro Rocks near the Long Wharf. Approximately 150 to 250 seals were reported using this site in 2002 and 2003 (San Francisco Estuary Project 2004). Large numbers of harbor seals have also been reported from Yerba Buena Island in Central Bay, where between 200 to 300 seals have been documented using this site between 1998 and 2002 (San Francisco Estuary Project 2004).

Harbor seal abundance in open waters of the project region is probably greatest near the Central Bay haul-out sites. The foraging range includes at least San Pablo Bay and may include Suisun Bay as well. No systematic data have been collected to describe their open-water distribution.

California sea lions have become a conspicuous part of the San Francisco Bay marine mammal fauna since about 1985. This species has a large and growing population breeding in the summer on island rookeries of the Southern California Bight (Bonnell and Dailey 1993). A portion of the population, mostly adult and subadult males, migrates northward in the fall to exploit runs of herring and anadromous fishes in northern California and the Pacific Northwest. Relatively small numbers establish themselves in the San Francisco Bay area (less than 2,000 animals) and are most abundant in the late fall through mid-spring.

California sea lions on land are nonbreeding migrants, typically adult and subadult males. In 2001, over 1,000 California sea lions were counted at Pier 39 in San Francisco during peak summer months (Marine Mammal Center 2002). Sea lions are occasionally seen at other scattered locations close to the Golden Gate and the outer coast.

The harbor porpoise was once a common species in the Bay and apparently still uses these waters, but sightings today are rare (Szczepaniak and Webber 1985). Individual animals almost certainly come and go within a larger range that includes waters off the outer coast. No data exist to describe the species' seasonal distribution in waters of San Francisco and San Pablo Bays. The abundance of harbor porpoises is apparently greatest near the Golden Gate and the outer coast.

Characteristics in Immediate Vicinity of the Long Wharf

This section describes the biological resources in the immediate vicinity of the Long Wharf. No site-specific sampling has been done of invertebrates and fishes in the immediate vicinity of the Long Wharf, but considerable data are available for the area between Point San Pablo and Castro Point north of the Long Wharf.

The benthic infauna has been sampled between Point San Pablo and Molate Point approximately 3.2 to 4.8 km (2 to 3 miles) north of the Long Wharf (USACE and Contra Costa County 1997). The nearshore stations had relatively high abundances and numbers of species (238 to 448 individuals and 11 to 25 species per station). However, diversity was low because the Asian clam, *Potamocorbula amurensis*, dominated the samples. Offshore samples had lower abundances and fewer species but, again, the Asian clam was heavily dominant (as high as 93 percent of all individuals at one station). In some areas tube mats of the amphipod, *Ampelisca abdita*, formed a dense covering on the sediment surface.

Common epibenthic invertebrates collected in trawls included several species of grass shrimp (*Crangon franciscorum, C. nigricauda, C. nigromaculata,* and *Heptacarpus* sp.). Crabs collected included the Dungeness crab (*Cancer magister*), the rock crab (*C. antennarius*), and decorator crabs (Majidae). An earlier survey in the same area (Jefferson Associates 1987) also collected large numbers of shrimp (*Crangon* spp. and *Palaemon macrodactylus*) in otter trawls, as well as Dungeness crabs and purple and yellow shore crabs (*Hemigrapsus nudus* and *H. oregonensis*). Crab pots between Point San Pablo and Point Molate regularly caught Dungeness crab but in relatively low abundance (Jefferson Associates 1987).

A number of fish surveys have been conducted north of the Long Wharf in the area between the Long Wharf and Point San Pablo (Jefferson Associates 1987; Herbold, Jassby and Moyle 1992; USACE and Contra Costa County 1997). In 1996, otter trawls were conducted offshore of Point Orient, about 4 kilometers (2.5 miles) north of the Long Wharf (USACE and Contra Costa County 1997). The most frequently caught fish was the plainfin midshipman. Other fish collected species included bay and cheekspot gobies, speckled sandab, northern anchovy, Pacific tomcod, white croaker, bay pipefish, staghorn sculpin, leopard sharks, and brown smoothhound.

Table 4.3-10 shows the fish species caught by otter trawl and midwater trawl in 1992 by CDFG at a station near the Richmond-San Rafael Bridge very close to the Long Wharf (Herbold, Jassby and Moyle 1992). The most commonly caught species included longfin smelt, northern anchovy, Pacific herring, staghorn sculpin, English sole, shiner perch, white croaker and speckled sanddab. Chinook salmon were caught by midwater trawl in spring (April through June).

Table 4.3-10
Most Abundant Fish Species Caught by CDFG in Trawls
Near the Richmond San Rafael Bridge

Season	Species Rank						# of Species
	1	2	3	4	5	6	
Midwater Trawl							
Jan-Mar	Longfin Smelt	Pacific Herring	Northern Anchovy				17
Apr-Jun	Northern Anchovy	Pacific Herring	Longfin Smelt	White Croaker	Chinook Salmon	Jacksmelt	23
Jul-Sep	Northern Anchovy	Pacific Herring	Shiner Perch	Longfin Smelt	Jacksmelt	White croaker	20
Oct-Dec	Northern Anchovy	Pacific Herring					17
Otter Trawl							
Jan-Mar	Longfin Smelt	Staghorn Sculpin	Shiner Perch	Northern Anchovy	Speckled Sanddab	English Sole	26
Apr-Jun	Longfin Smelt	English Sole	White Croaker	Speckled Sanddab	Northern Anchovy	Staghorn Sculpin	27
Jul-Sep	Staghorn Sculpin	Longfin Smelt	Northern Anchovy	Speckled Sanddab	Shiner Perch	Plainfin Midshipman	26
Oct-Dec	Longfin Smelt	Northern Anchovy	English sole	Shiner Perch			24

In a 1986 survey at a station off Pt. Molate, the most abundant bottom fishes recorded in trawls were plainfin midshipman, white croaker, longjaw mudsuckers, staghorn sculpin, shiner perch and English sole (Jefferson Assoc. 1987). The most abundant water column fishes recorded in the 1986 survey were northern anchovy, longfin smelt and Pacific herring.

Figure 4.3-5 shows sensitive habitats in the vicinity of the Long Wharf. Eelgrass beds occur along most of the shoreline in the vicinity of the Long Wharf, as well as off Red Rock Island.

Significant rocky habitat near the Long Wharf occurs at Red Rock Island and Castro Rocks. Harbor seals haul out on both of these islands. Castro Rocks is especially important to harbor seals. Between 30 and 60 harbor seals use this area for breeding in the spring between mid-March and mid-June (USCG and OSPR 1997). As many as 150 to 250 seals haul out at this site during the winter.

Figure 4.3-5 – Habitats in Vicinity of Long Wharf

Bird colonies on Red Rock Island include western gulls and black-crowned night herons (Carter et al. 1992). Western gulls also breed at Castro Point, the Richmond-San Rafael Bridge, and on the Long Wharf.

An important colony of double-crested cormorant, a California Species of Special Concern, is found on the Richmond-San Rafael Bridge near the Long Wharf. This colony was studied between 1988 and 1990 (Stenzel et al. 1991). Cormorants nested on a variety of structures on the bridge. All nests were situated in the lattice work of girders beneath the lower bridge deck. Many nests were located on the north and south cord girders, which act as major structural supports between piers. The number of nesting attempts on the bridge was 296 in 1988, 394 in 1989, and 424 in 1990. The number of chicks fledged per nesting attempt was about 0.98 in 1988, 1.77 in 1988, and 1.7 in 1990. Productivity on the bridge was about average compared to other double-crested cormorant colonies. Cormorants on the Richmond-San Rafael Bridge eat primarily plainfin midshipman but also shiner perch, yellowfin goby, jacksmelt, northern anchovy, Pacific staghorn sculpin and white croaker.

Outer Coast

This section on the outer coast was summarized from the Unocal EIR (Chambers Group 1994) and the GTC Gaviota Marine Terminal Supplemental EIR/S (Aspen Environmental Group 1992). More detail on the outer coast can be found in those documents.

The North Coast from Monterey Bay to the Oregon Border

The outer coast of California from Monterey Bay to the Oregon border comprises a productive and diverse environment for marine life. Compared to the southern California coastline, which has been subjected to intense human activity, the marine environment of the north coast is relatively pristine. The area includes bays, estuaries, dramatic rocky headlands, and offshore reefs and kelp beds.

Intertidal and Subtidal Habitats

Much of the coastline of northern California consists of rocky substrate. The percentage of rocky compared to sandy beach ranges from 32 percent in Humboldt County to 77 percent in Sonoma County. Communities of intertidal organisms have been found to be considerably different in different locations in northern California (Kinnetic Laboratories, Inc. 1992). In particular, rocky shores exhibit community diversity and complexity that are generally higher than in other types of coastal biological communities; variation among locations is often extreme. Just as there is much rocky intertidal habitat along the coast of northern California, there is also much rocky subtidal. The location of offshore reefs, offshore rocks, and subtidal hard bottom substrate roughly correlates with the sections of coast that have rocky intertidal habitat.

Major offshore reefs include St. George Reef off Crescent City, Tolo Bank about 40 miles north of Fort Bragg, Cordell Bank offshore from Point Reyes, and the area around the Farallones (BLM 1980).

The most species-rich intertidal areas are those of the protected outer rocky shore (Winzler and Kelly 1977). The protected open coast lies within open bays or along a shoreline protected by a headland, an offshore island, or an offshore rocky reef. Kelp beds also tend to diminish the force of waves breaking on shore.

Along the northern California coast, these protected open coast areas include the leeward side of Bodega Head and Point Reyes, at Half Moon Bay, and at Año Nuevo Island. The diverse marine life of the protected outer coast rocky intertidal is described in Ricketts, Calvin, and Hedgpeth (1985). Characteristic species of the protected outer coast rocky intertidal habitat include the feather boa kelp (*Egregia menziesii*); rockweeds, especially *Fucus distichus*, red algae of the genus *Gigartina*; the aggregate sea anenome (*Anthopleura elegantissima*); and giant green anemone (*Anthopleura xanthogrammica)*.

The unprotected rocky shore is an environment of relentless pounding surf. These rigorous conditions of heavy surf provide a habitat where only those plants and animals with special adaptations to withstand the brutal wave shock can live. Because of the demanding physical conditions of the unprotected rocky shore, diversity is much lower than on the protected coast. The most representative association in this habitat is the mid-intertidal mussel bed community dominated by the California mussel (*Mytilus californianus*), the gooseneck barnacle (*Pollicipes polymerus*), and the ochre sea star (*Pisaster ochraceus*) (Winzler and Kelly 1977; Ricketts, Calvin, and Hedgpeth 1985).

Deep offshore reefs are usually covered with dense diverse growths of marine invertebrates. There is often a wide diverse sponge assemblage; on some offshore banks, such as Cordell Bank off Point Reyes, populations of the hydrocoral, *Allopora californica*, can be found (Chambers Group 1994).

Most of the kelp along the northern California coast occurs from Mendocino County south. Seasonal bull kelp, *Nereocystis leutkeana*, has been observed to grow prolifically on submerged and tidal rocks off Trinidad Head in Humboldt County (Boyd 1979). Kelp beds are sparse and isolated between Cape Vizcaino and Cape Mendocino, probably because of turbidity from the many streams which run off into the area (USFWS and Institute of Marine Sciences 1986). Large dense kelp beds occur along a 12- to 15-mile stretch of coastline between Cape Vizcaino and Bruhel Point and for approximately 40 miles from Laguna Point to Elk Creek. The kelp beds in this area are primarily composed of the annual bull kelp, *Nereocystis*, and lie mostly between 0.5 and 0.75 mile offshore. Between Saddle Point and Point Arena, the kelp beds are sparse and scattered. South of Point Arena, the kelp beds again form a nearly continuous band for a distance of about 60 miles down the coast to Fort Ross Reef in Sonoma County.

Although *Nereocystis* is the dominant kelp along this northern coast, giant kelp (*Macrocystis* spp.) occurs as far north as Bear Harbor, which is 6 miles south of Point Delgada at the border between Mendocino County and Humboldt County. In some places within this area, *Macrocystis* is locally abundant. Most *Macrocystis* along the north coast is considered to be *Macrocystis integrifolia* (USFWS and Institute of Marine Sciences 1986). *Macrocystis* is generally found in the lee of points. From Fort Ross south there is little kelp until Año Nuevo Point at the border between San Mateo and Santa Cruz Counties. Between Point Año Nuevo and Santa Cruz, *Macrocystis* stands are patchy and interspersed with significant stands of *Nereocystis* (Van Blaricom in BLM 1980). The relative abundances of these two types of kelp in this area can change dramatically from year to year, depending on the severity of winter storm seasons.

Sandy intertidal and shallow subtidal communities along the northern California outer coast are dominated by a relatively few species adapted to an environment of constantly shifting sands. Characteristic sandy intertidal species include beach hoppers (*Orchestoidea corniculata* and *O. benedicti*), lugworms (*Arenicola* spp.), mole crabs (*Emerita analoga*), and razor clams (*Silqua patula*) (Winzler and Kelly 1977). Species diversity increases with increasing depth in the outer coast subtidal.

Fishes

Because of the high productivity of its coastal waters and its many diverse habitats, the north coast of California is extremely rich in marine life. The area supports a number of important commercial and recreational ocean fisheries. To a large extent, important fisheries habitats are correlated with other significant biological habitats discussed elsewhere in this section. For example, offshore reefs and kelp beds are important to rockfishes (*Sebastes* spp.), lingcods, kelp greenlings, and some kinds of surfperch; river mouths are important to anadromous fishes; and estuaries are important to starry flounder, which spend their younger years in estuaries.

Particularly important water column fishes in northern California waters include northern anchovy, Pacific herring, and Pacific hake. Northern anchovy are one of the most abundant fishes off California. They are an important prey item for larger fishes, birds, and marine mammals. They tend to be most abundant from San Francisco Bay south (MBC 1987).

Pacific herring spawn throughout intertidal and subtidal locations along California's coast, but Tomales Bay and San Francisco Bay have the largest spawning populations. In California, the herring spawn in the Bays primarily from December to February and recently into March. The adhesive eggs are laid on vegetation, rocks, and pilings in large masses (Barnhart 1988).

Pacific hake eggs, larvae, juveniles, and adults are pelagic. Juveniles are generally restricted to waters overlying the continental shelf and slope where they occur from the surface to depths of 656 ft (200 m) (MBC 1987). Adults are found from the surface to .6 miles (914 m), but are most common between 50 and 500 m and most abundant at depths between 90 and 180 m. Over the shelf and slope, Pacific hake are most common 10 to 30 m above the bottom, although they may be found several hundred meters off the bottom. The coastal subpopulation of Pacific hake undertake an extensive annual migration from spawning areas in the south to feeding areas in the north (MBC 1987). Pacific hake are found moving up the northern California coast from the south in late spring and downcoast again in fall. The waters offshore Cape Mendocino have high concentrations of Pacific hake (MBC 1987).

Rocky areas and kelp beds generally contain high concentrations of fishes. The attraction of fishes to reefs and kelp is apparently the result of several factors, including attraction to solid objects, schooling behavior, visual orientation, and availability of food and shelter (DeWitt and Welsh 1977).

Over 30 species of rockfish, *Sebastes* spp., are found in central and northern California coastal areas. Rockfishes are important in the diet of anadromous fishes and also are important in the local sport and commercial fisheries. Other common fishes in rocky areas are a variety of small sculpins (Family Cottidae), surfperch (Family Embiotocidae), and lingcods and greenlings (Family Hexagrammidae).

Flatfishes are especially adapted for life on soft bottoms. They are one of the most important groups of fishes taken in the commercial trawl fishery. The major species in the trawl catch are Dover sole, English sole, petrale sole, rex sole, starry flounder, Pacific sanddab, arrowtooth flounder, and (from San Francisco south) California halibut.

Important salmonid anadromous fishes in northern California include king or Chinook salmon, silver or Coho salmon, pink salmon, steelhead rainbow trout, coastal cutthroat trout, and brown trout. Of the three species of northern California salmon, Chinook and Coho are the most abundant (DeWitt and Welsh 1977).

In addition to the anadromous salmonids, two other introduced species of anadromous fish occur in the study area. These are the striped bass and the American shad. American shad spawn in the Sacramento, San Joaquin, Eel, Klamath, and Trinity Rivers in northern California (Dewitt and Welsh 1977). The only significant striped bass populations in California are in the Sacramento Delta – San Francisco Bay Area. During the summer months there may be aggregations of striped bass feeding on anchovies in the surf zone from San Francisco to Pacifica beaches (Chambers Group 1994). Some small populations of striped bass exist in the Russian and Salinas rivers and in Elkhorn Slough.

<u>Wetlands</u>

Along the northern California coast, coastal wetlands are ecologically important. Unlike southern California wetlands that have been decimated by development so that less than 10 percent of their historic area remains, northern California still has a substantial amount of functional wetland habitat. In coastal wetlands north of San Francisco there are still approximately 3,147 hectares of saltmarsh, 4,199 hectare of tidal flats, and

10,518 hectares of open water (BLM 1980). Approximately 79 percent of the estuaries north of San Francisco are important fish nursery areas and 62 percent are at the entrance of anadromous fish streams (BLM 1980). Coastal wetlands along the northern California coast include several major bays and major river mouths.

Birds

The avifauna of the outer coast consists of more than 100 species of seabirds and shorebirds, about 35 of which are abundant in a given season (Briggs et al. 1983). Most have cool-water affinities, but the fauna also includes a few subtropical species, particularly in the late-summer and fall. Total abundance of marine birds varies greatly from year to year as a result of oceanographic conditions. Highest abundance occurs in waters over the continental shelf (less than 656 ft (200 m) depth), nearshore waters within sight of land, and on the shore.

The nesting fauna includes 17 species that build nests, scrapes, or tunnels on isolated islands, rocks, and cliff faces where terrestrial predators are absent or rare. The most numerous of the nesting species are the common murres, Cassin's auklet, Brandt's cormorant, and western gull (Carter et al. 1990). Common murres have colonies at 21 locations from the Farallones Islands to Castle Rock off Crescent City, with a combined population of about 350,000. Cassin's auklets have colonies at only three sites and have a northern California population of 41,000. Other alcids nesting along the northern California coast include the pigeon guillemot, with 8,300 birds distributed among 140 sites, the rhinoceros auklet, with 1,700 birds found at 23 sites, and the tufted puffin, with about 300 birds found at 13 sites. A noncolonial alcid of the northern California coast is the marbled murrelet, which nests in old growth trees well inland in coastal forests from Monterey Bay northward.

Brandt's cormorants have colonies at 50 locations with a nesting population in the north coast area of over 35,000 birds. Two other cormorant species also are abundant: the pelagic cormorant and the double-crested cormorant, with populations of about 11,000 and 6,500, respectively. Pelagic cormorants breed at nearly 140 sites, while the double-crested cormorant has colonies at only 20 sites. Western gulls are the most ubiquitous nesting species along the northern coast, found at about 180 sites; recent censuses place the population at over 30,000 birds.

Other prominent nesting species are the storm-petrels. These birds nest in burrows on islands and rocks at 12 locations along the northern California coast. The Leach's storm-petrel is the most abundant, with a nesting population of nearly 11,000 birds; largest colonies are located on Little River Rocks and Trinidad Bay Rocks (Carter et al. 1992). Ashy storm-petrels have a large colony of 4,000 birds on South Farallones Island, representing 85 percent of the world population of the species.

Large numbers of birds of several species use the area seasonally but do not have local breeding populations. These include migrants, peaking in fall and spring, or birds that over-winter in California waters. The winter fauna of loons, grebes, and scoters includes red-throated, Pacific, and common loons; horned, red-necked, eared, and western/Clark's grebes; and surf and white-winged scoters. These species are at greatest abundance close to shore in the Farallones Basin and in Monterey Bay. Because they concentrate during the night on sheltered nearshore waters, loons, grebes, and scoters are especially vulnerable to contact by oil. Brown pelicans (endangered) are a summer-fall visitor with roosts at 30 or more locations along the outer coast.

In addition to seabirds, the avifauna of the northern California coast includes a variety of shorebirds. Black oystercatchers nest along the northern California coast at about 20 known locations; the species is not considered colonial and numbers at any single site rarely exceed 10 birds (Carter et al. 1992). During the remainder of the year, black oystercatchers are gregarious and forage in intertidal rocky areas for mussels, limpets, and chitons. Shorebirds foraging on the mudflats and sandy beaches of the northern California coast are predominantly migrants and include the same species found in San Francisco Bay. Mudflats and sandy beaches along the north coast occur mostly in or near Humboldt Bay, the mouths of some larger rivers, Bodega and Tomales Bay, Point Reyes and nearby estuaries, and Bolinas.

Mammals

Northern California has a rich marine mammal fauna. The cetacean fauna off central and northern California is comprised of at least 20 species, but 90 percent of all numbers occur in schools of northern right-whale dolphins, Pacific white-sided dolphins, and Risso's dolphins (Dohl et al. 1983).

Gray whales are the most abundant baleen whales off the central and northern California coast. From December through April, most of the world population of about 21,000 animals migrate along the shore between feeding grounds in the Bering Sea to calving lagoons in Baja California. Gray whales typically summer on feeding grounds in the Bering Sea; however, small numbers (<12) are also found in the summer at several locations along the coast, including Saint George Reef, off the mouth of the Klamath River, off Big Lagoon and Patrick's Point, and in the Gulf of the Farallones (Dohl et al. 1983).

The southbound migration to calving grounds in Mexico occurs off California, predominantly in December and January. Most animals are found within 2 to 2.5 miles (3 to 4 km) from shore, although a small portion of sightings (6.5 percent) are recorded at distances greater than 11.2 miles (18 km or10 nm). Most whales seen farther from land are those taking a direct route from headland to headland across Monterey Bay and the Gulf of the Farallones. Blue, fin, and humpback whales (all endangered) typically are found in greatest abundance off central and northern California in the summer and fall when they feed on euphausiid crustaceans in the Gulf of the Farallones and Monterey Bay.

Six species of pinnipeds occur off central and northern California, although one, the Guadalupe fur seal (threatened), is very rare in these waters. Each species has its season of greatest abundance in the area. Northern fur seals are common off central and northern California in the winter and spring when waters far offshore are occupied by thousands of migrants from the Pribilof Island rookeries (Bonnell et al. 1983).

California sea lions are abundant off central and northern California in the fall, when numbers reach about 24,000 animals (Bonnell et al. 1983). Animals migrating into these waters are typically juvenile and adult males that feed on herring and salmonids in nearshore waters and rivermouths, and hake (Pacific whiting) farther offshore. On shore, large numbers are found on rocks and breakwaters in the Monterey Bay area, on Ano Nuevo Island, on the Farallones, at Bodega Rock and in Tomales Bay, and on many rocks off Mendocino, Humboldt, and Del Norte Counties. They typically breed only on large rookeries on islands off southern California and Mexico (Bonnell et al. 1983).

Steller sea lions (threatened) currently have rookeries in California on Ano Nuevo Island, Southeast Farallones Island, Sugarloaf Rock off Cape Mendocino, and southwest Seal Rock off Crescent City.

Northern elephant seals have a world population of over 100,000 animals occupying a breeding range from mid-Baja California to Point Reyes. About 95 percent of the total numbers are associated with colonies in southern California and Mexico. In central and northern California, northern elephant seals breed on the mainland at Cape San Martin, at Ano Nuevo Island and adjacent mainland point, on the Farallones Islands, and at Point Reyes (Bonnell et al. 1983; Allen et al. 1989). Elephant seals also haul out on the St. George Reef in Del Norte County, and at Simpson Reef in southern Oregon.

Harbor seals have a growing population of 27,863 animals in California, where they haul out at hundreds of locations (Carretta et al. 2004). Maximum numbers on land occur in the late-spring when pups are born and in mid-summer when most adults undergo their annual molt. About one-half of theState's total are found from Monterey Bay northward. Important nursery locations in northern California are Bolinas Lagoon, Double Point, Drakes Estero, Point Reyes, Tomales Bay, Laguna Point north of Fort Bragg, Mistake Point, Sisters Rocks, Humboldt and Arcata Bays, and St. George Reef (Bonnell et al. 1983; Allen 1989).

The federally threatened Southern California sea otter ranges northward to about Point Ano Nuevo. That portion of the population north of Monterey consists predominantly of nonreproductive males, although mother-pup pairs are occasionally seen (Estes and Jameson 1983; Bonnell et al. 1983).

The South Coast from Monterey Bay to the Mexican Border

There are three distinct coastal regions within the south coast area: (1) the southern California mainland coast south of Point Conception, (2) the eight California Channel

Islands in the southern California Bight and (3) the central California coast between Point Conception and Santa Cruz. The area near Point Conception is a transition zone between the colder water Oregonian Province and the warmer water California Province. The oceanographic and biological significance of Point Conception as a major transition zone is well known. Marine invertebrate, fish, and algal assemblages differ north and south of Point Conception, with species adapted to cold water to the north and marine life adapted to warmer waters to the south. The eight channel Islands are prominent features of the Southern California Bight.

<u>Intertidal and Subtidal Habitat</u>

The intertidal area of the Southern California Bight is approximately 70 percent sandy beach, 7 percent boulder, and 23 percent rocky intertidal along the mainland coast and approximately 21.5 percent sandy beach, 16 percent boulder, and 52.5 percent rocky intertidal along the Channel Island coast. Approximately 55 percent of the coast north of Point Conception is rocky intertidal. As was true of the northern California outer coast, rocky assemblages are far more diverse than those of sandy beaches.

The southern California Bight has a diverse bottom substrate that ranges from rock through fine sediments and supports a highly diverse and complex fauna. Subtidal hard bottom substrates are relatively scarce and tend to be located offshore of points such as Coal Oil Point, Point Dume, the Palos Verdes Peninsula, Dana Point, La Jolla, and Point Loma. Nearshore subtidal substrates around the Channel Islands are mostly rocky outcrops, rock/sand combinations, and coarse sediments. Nearshore rocky substrates of the islands support a rich macrophytic cover and a spectacular array of marine invertebrates. North of Point Conception, exposed hard bottom areas occur primarily in shallow nearshore waters from Point Conception to Point Estero, along the Big Sur coastline, and off the Monterey Peninsula.

Kelp bed communities are mostly associated with rocky substrate, but along the mainland of the Santa Barbara Channel occur on soft bottom. Kelp bed communities differ north and south of Point Conception. North of Point Conception, the canopy kelp may be either giant kelp or bull kelp or a combination of both species. In southern California the canopy consists mainly of giant kelp, although a southern bull kelp (*Pelagophycus porra*) may be present off San Diego and Catalina Island. Kelp beds occur around Point Santa Cruz and Soquel Point in Santa Cruz, from the Monterey Peninsula south to Estero Bay, between Point Arguello and Point Conception, along the Santa Barbara coast, along the Malibu coast, around the Palos Verdes Peninsula, from Corona del Mar to Dana Point, off northern San Diego County, La Jolla and Point Loma. Prior to the 1983 El Nino, the Santa Barbara County mainland coast between Point Conception and Santa Barbara Point supported a nearly continuous kelp bed that grew primarily on sand substrate. This bed was destroyed by the El Nino and never completely recovered. Lush beds of giant kelp ring all of the Channel Islands.

Fishes

Nearshore waters from Santa Cruz to the Mexican border offer a great diversity of prey and habitat for fishes. Many embayments serve as fish nurseries, and numerous species of fish larvae are found in the water column. Pelagic nearshore schooling fish include Pacific barracuda, northern anchovy, Pacific herring, jack mackerel, and Pacific bonito. Northern anchovy are among the most abundant species and are important in the food webs of larger fishes, seabirds, and marine mammals. Rockfish are abundant in rocky areas, reefs, and kelp beds. Garibaldi, sheephead, seniorita, opaleye, and kelp bass are found in rocky areas, reefs, and kelp beds. Sandy bottoms along the coast support flatfish including Pacific and speckled sanddab, California halibut, and Dover sole. Rockfish of the genus *Sebastes* are common throughout the region, but are most diverse and dominant north of Point Conception.

Wetlands

Southern California coastal wetlands are a unique and productive habitat that has almost been lost to major development. As recently as 100 years ago, a series of vast coastal wetlands occurred along the southern California coast. Approximately 90 percent of the bays and estuaries in southern California have been severely altered or destroyed by human activities. Recently, a number of restoration efforts have been initiated to reverse the process. Most coastal drainages have a tidal wetland where they meet the ocean. Major Central and Southern California estuarine systems include Elkhorn Slough in Monterey Bay, Morro Bay in Central California, Devereux and Goleta Sloughs as well as Carpinteria Marsh in Santa Barbara County, Mugu Lagoon in Ventura County, Anaheim Bay, the Bolsa Chica wetlands and Newport Bay in Orange County, San Elijo Lagoon, Batiquitos Lagoon, Los Penasquitos wetlands, San Diequito wetlands, and Tijuana Slough in San Diego County. Coastal wetlands provide wintering habitat for a number of shorebird, waterfowls and seabird species, and provide breeding habitat for several sensitive species, including the light-footed clapper rail, Belding's savannah sparrow, and California least tern.

Birds

The Southern California Bight provides nearshore and offshore habitats for more than 195 marine bird species (Baird 1993). Most of the species are not residents, but rather use the region for over-wintering and/or migration. The most abundant species include the Pacific loon, Brandt's cormorant, surf scoter, phalaropes, sooty shearwater, California gull, Bonaparte's gull, and Heermann's gull. At least 17 species are known to nest in the Bight, the majority of them on the Channel Islands. The Channel Islands and their surrounding waters are the most important marine bird habitats in the Southern California Bight, especially San Miguel and Anacapa Islands. San Miguel Island supports the largest number and diversity of marine bird species in the Bight. Eleven species breed on San Miguel Island and represent 60 percent of the southern California nesting seabird population. Anacapa Island supports the largest California brown pelican and western gull colonies as well as double-crested, Brandt's, and pelagic cormorants. Table 4.3-11 shows marine bird breeding colonies on the northern Channel Islands. Only western gulls breed on Santa Catalina Island, while Brandt's cormorants, black oystercatchers, and western gulls breed on San Nicolas Island and San Clemente Island (Carter et al. 1992).

Table 4.3-11
Marine Bird Breeding Colonies on the Northern Channel Islands

Species	Mainland	San Miguel Island	Santa Rosa Island	Santa Cruz Island	Anacapa Island	Santa Barbara Island
Leach's storm petrel		+				
Ashy storm petrel		+		+		+
California brown pelican					+	+
Double-cresteed cormorant		+			+	+
Brandt's cormorant	+	+	+	+	+	+
Pelagic cormorant	+	+	+	+	+	+
Western gull	+	+	+	+	+	+
California least tern	+					
Pigeon guillemot	+	+	+	+	+	+
Xantus' murrelet						+
Cassin's auklet		+		+		
Rhinoceros auklet	+	+				
Tufted puffin		+				
Sources: Hunt et al. 1980; Sowls et al. 1980; Gress 1991; Ingram 1991.						

North of Point Conception, the rugged coastline supports a rich marine avifauna. Breeding seabirds include western gull, black oystercatcher, common murre, pigeon guillemot and Brandt's, double-crested, and pelagic cormorants. The waters of Monterey Bay are especially important to seabirds. Thousands of storm-petrels, including a significant portion of the world's ashy storm-petrel population and nearly 6,000 California brown pelicans, occur in autumn (Dohl et al. 1983). Over 500,000 shearwaters, murres, and phalaropes feed in Monterey Bay in May and June.

The coastal waters between Point Piedras Blancas to Point Sal are also important to seabirds. Thousands of grebes, murres and scoters are found in autumn through winter in these waters. About 20 percent of the brown pelicans that migrate northward along the coast are found on coastal roosts here in July through October (Dohl et al. 1983).

Marine Mammals

The Southern California Bight has one of the largest and most diverse marine mammal populations in the world (Bonnell and Dailey 1993). It includes eight species of baleen whales; more than a dozen species of porpoises, dolphins, and other toothed whales; six species of pinnipeds; and the southern sea otter. In some seasons, the combined abundance of marine mammals in the Southern California Bight may reach 150,000 animals representing as many as 30 different species. Gray whales, common dolphins, bottlenose dolphins and Pacific white-sided dolphins, are the most common cetacean species in coastal waters near the mainland.

Six species of pinniped are found in the Southern California Bight. The California sea lion and harbor seal are the only species commonly found near mainland shores. The California sea lion is the most abundant pinniped in the Southern California Bight. Important seal and sea lion rookeries and haulout beaches exist on the Channel Islands, especially at San Miguel and San Nicolas Islands. Pinnipeds that breed on San Miguel Island include northern fur seal, California sea lion, Northern elephant seal, and harbor seal. California sea lions also breed on San Nicolas, Santa Barbara, and San Clemente Islands. The principal breeding colonies are on San Miguel and San Nicolas Islands (Bonnell and Dailey 1993). Two other pinniped species, the Guadalupe fur seal and northern (Steller's) sea lion, are occasional visitors to the Southern California Bight.

Individual sea otters are regularly seen in the area just south of Point Conception. Sea otters were transplanted to San Nicolas Island in 1987. Although the transplant was generally unsuccessful, a few individuals may persist in the area.

The most common cetacean species in Central California north of Point Conception include Pacific white-sided dolphin, northern right whale dolphins, Risso's dolphins, Dall's porpoise, and harbor porpoise. Baleen whales are numerically a minor element of the cetacean fauna. Gray whales pass through the area in migration. Humpback whales are becoming a permanent part of the Central Coast cetacean fauna during most of the year. Slope waters west of the Big Sur coast are used heavily by cetaceans. Risso's dolphins are present year-round and large numbers of northern right whale dolphins and moderate numbers of Dall's porpoises are present in winter. Offshore waters are used heavily by migrating blue and fin whales. Five species of pinniped are found in central California. These species include California sea lion, Steller sea lion, northern fur seals, northern elephant seals, and harbor seals. A small northern elephant seal rookery has been established at Cape San Martin. Large numbers of California sea lions haul out in summer and autumn at Point Piedras Blancas, Lion and Pup Rocks near Point Buchon, and at Point Sal Rock.

Most of the southern sea otter population is found between Monterey and the Santa Maria River.

Rare/Threatened/Endangered Species

Table 4.3-12 lists the sensitive species of the outer coast.

4.3.2 Regulatory Setting

Several Federal, State, and local agencies have jurisdiction over the biological resources of the San Francisco Bay-Delta estuary. Federal agencies directly responsible for the protection of biological resources are the U.S. Fish and Wildlife Service (USFWS) and the National Oceanographic and Atmospheric Administration (NOAA) Fisheries. The U.S. Environmental Protection Agency (EPA) is also concerned with the protection of marine and estuarine life through the regulation of water quality standards.

The California Department of Fish and Game (CDFG) is responsible for the protection of biological resources at the State level, as well as species officially listed as threatened or endangered by the State, candidates for listing as threatened or endangered, and California Species of Special Concern. The CDFG also regulates fishing and hunting and protects habitat quality. In addition, the CDFG administers the California Oil Spill Prevention and Response Act. The California Coastal Commission (CCC) is responsible for coastal zone management along the coast, except for San Francisco Bay. The California State Water Resources Board sets water quality standards for the protection of aquatic life. These standards are overseen on a local level by the SF-RWQCB.

The San Francisco Bay Conservation and Development Commission (BCDC) is responsible for coastal zone management within the San Francisco Bay/Delta estuary. The BCDC regulates dredging, filling, and land use in San Francisco Bay below the line of highest tidal action as well as 100 feet inland of the line of highest tidal action.

Legislation applicable to the protection of biological resources in San Francisco Bay-Delta estuary and the California outer coast is discussed in the following sections.

Federal Acts

Clean Water Act (CWA) of 1972

The CWA was established to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Specific sections of the CWA control the discharge of pollutants and wastes into freshwater and marine environments. Sections 401 of the CWA addresses dredging activities, and requires that dredging and disposal activities must not cause concentrations of chemicals in the water column to exceed State standards. Section 404(b)(1) guidelines require that dredging and disposal activities should have no unacceptable adverse impacts on the ecosystem of concern.

Table 4.3-12
Sensitive Species of the Outer Coast

Common Name/Scientific Name	Category	Habitat
Fish		
Green sturgeon *Acipenser medirostris*	Federal Proposed Threatened	Open ocean, rivers and creeks
Tidewater goby *Eucyclogobius newberryi*	Federal Endangered; State Threatened	Brackish water; shallow lagoons, lower stream reaches
Chinook salmon southern Southern Oregon and California Coast ESU *Oncorthynchus tshawaytscha*	Federal Threatened	Rivers and creeks, open ocean - Northern and Central California
Spring run Chinook salmon *Oncorthynchus tshawaytscha*	Federal Threatened State Threatened	Open ocean - Northern and Central California
Winter run Chinook salmon *Oncorthynchus tshawaytscha*	Federal Endangered State Endangered	Open ocean - Central and Northern California
Steelhead Central California ESU *Oncorthynchus mykissi*	Federal Threatened State Species of Special Concern	Coastal basins: rivers, creeks, and streams, open ocean - Northern and Central California
Steelhead Southern/Centralalifornia ESU *Oncorthynchus mykissi*	Federal Threatened State Species of Special Concern	Rivers and tributaries, open ocean - Central and Southern California
Coho salmon Southern Oregon/NorthernCalifornia ESU *Oncorhynchus kisutch*	Federal Threatened State threatened	Rivers, open ocean - NorthernCalifornia
Coho salmon Central California ESU *Oncohynchus kisutch*	Federal Threatened State Endangered	Streams, open ocean - Central California
Pink salmon *Oncorhynchus gorbuscha*	State Species of Special Concern	Coastal streams; open ocean
Birds		
Marbled murrelet *Brachyramphus mamoratus*	Federal Endangered State Endangered	Coastal ranges: old growth trees, and forage in open coastal waters
American peregrine falcon *Falco peregrinus*	State Endangered	Coastal areas: nest on high cliffs, coastal habitats
California brown pelican *Pelecanus occidentalis*	Federal Endangered State Endangered	Coastal areas: along shores and neritic waters, breed on Anacapa and Santa Barbara Islands
Common loon *Gavia immer*	State Species of Special Concern	Nearshore waters, bays, and estuaries
California gull *Larus californicus*	State Species of Special Concern	Shore and neritic waters
Rhinoceros auklet *Cerorhinca monocerata*	State Species of Special Concern	Castle Rock and South Farallones Island colonies

Table 4.3-12 (continued)
Sensitive Species of the Outer Coast

Common Name/Scientific Name	Category	Habitat
Tufted puffin *Fratercula cirrhata*	State Species of Special Concern	Beyond shelf breaks of Prince Island, Castle Rock, Green Rock, Fish Rocks, and South Farallones Island
Double-crested cormorant *Phalacrocorax aurits*	State Species of Special Concern	Breed on rocks and islands of Outer Coast
Western snowy plover *Charadrius alexandrinus*	Federal Threatened State Species of Special Concern	Coastal: sand substrate above high-tide line on beaches backed by cliffs, margins of estuaries, lagoons, or salt flats
California least tern *Sterna antillarum browni*	Federal Endangered State Endangered	Open coast areas: sandy beaches and bays
Sea otter *Enhydra lutris*	Federal Threatened	Coastal areas; feed within 1-2 km off shore, population mostly in Central California
Guadalupe fur seal *Arctocephalus townsendi*	Federal Threatened State Threatened	Pelagic range: waters offshore California
Steller sea lion *Eumetopias jubatus*	Federal Threatened	Breed on 4 rookeries in California
Humpback Whale *Megaptera novaeangliae*	Federal Endangered	Shelf and slope waters (<2,000 m depth)
Blue whale *Balaenoptera musculus*	Federal Endangered	Waters beyond the shelf break
Fin whale *Balaenoptera physalus*	Federal Endangered	Over the shelf and slope areas of waters
Sei whale *Balaenoptera borealis*	Federal Endangered	Pelagic waters, though not over the shelf and slope
Right whale *Eubaleana glacialis*	Federal Endangered	Coastal Waters of North Pacific from Baja, CA to the Bering Sea
Sperm whale *Physeter catodon*	Federal Endangered	Deep waters off of California (1,800 m or deeper)
Reptiles		
Leatherback sea turtle *Demochelys coriacea*	Federal Endangered	Warm coastal waters over the shelf
Green sea turtle *Chelonia mydas*	Federal Endangered	Coastal waters
Loggerhead sea turtle *Caretta caretta*	Federal Endangered	Coastal waters
Pacific Ridley turtle *Lepidochelys olivacea*	Federal Endangered	Coastal waters

Section 303(d) of the Clean Water Act requires that states develop a list of waterbodies that need additional work beyond existing controls to achieve or maintain water quality standards. The additional work includes the establishment of total maximum daily loads of pollutants that have impaired the waterbody.

The National Estuary Program was established in 1987 by amendments to the CWA to identify, restore, and protect nationally significant estuaries of the United States. The San Francisco Estuary Project is one of over 20 Estuary Projects established by the National Estuary Program. The San Francisco Estuary Project is a cooperative Federal, State and local program to promote effective management of the San Francisco Bay-Delta Estuary.

Marine Protection, Research, and Sanctuaries Act of 1972

Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) regulates the transportation and disposal of material in the ocean, and includes regulations and restrictions on the type of material that may be disposed. The U.S. Army Corps of Engineers (USACE) and EPA may prohibit or restrict disposal of material that does not meet the criteria outlined in 40 CFR Part 227.

Fish and Wildlife Coordination Act of 1958

The Fish and Wildlife Coordination Act requires that whenever a body of water is proposed to be controlled or modified, the lead agency must consult the State and Federal agencies responsible for fish and wildlife management (USFWS, CDFG, and NOAA). This act allows for recommendations addressing adverse impacts associated with a proposed Project, and for mitigating or compensating for impacts on fish and wildlife.

Marine Mammal Protection Act

The Marine Mammal Protection Act prohibits the taking (including harassment, disturbance, capture, and death) of any marine mammals except as set forth in the act.

Coastal Zone Management Act of 1972

The Coastal Zone Management Act requires Federal agencies conducting activities directly affecting the coastal zone to proceed in a manner consistent with approved State coastal zone management programs.

Endangered Species Act of 1973

The Endangered Species Act protects threatened and endangered species by prohibiting Federal actions that would jeopardize the continued existence of such species or adversely affect the critical habitat of these species. The act requires the agencies to consult the USFWS and NOAA, which will evaluate the potential impacts of all aspects of the project on any threatened or endangered species, and provide alternatives or measures to minimize effects caused by a proposed Project.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act protects certain migratory birds including all seabirds by limiting hunting, capturing, selling, purchasing, transporting, importing, exporting, killing, or possession of the birds, or their nests or eggs.

Oil Pollution Act of 1990

The Oil Pollution Act of 1990, along with the Oil Pollution Liability and Compensation Act of 1989, provides for cleanup authority, penalties, and liability for oil pollution. The Oil Pollution Act creates the Oil Spill Compensation Fund to pay for removal of and damages from oil pollution.

National Invasive Species Act of 1996

This act calls for the implementation of measures to halt the spread of invasive species. To comply with this act, the USCG proposes voluntary guidelines to control the invasion of aquatic nuisance species via ship ballast water (North 1998). On July 28, 2004, the U.S. coast Guard published regulations establishing a national mandatory ballast water management program for all vessels equipped with ballast water tanks that enter or operate within U.S. waters. These regulations also require vessels to maintain a ballast water management plan that is specific for that vessel.

Magnuson-Stevens Fishery Management and Conservation Act, as amended (16 U.S.C. 1801 et seq.)

The 1996 amendments to the Magnuson-Stevens Fishery Management and Conservation Act set forth a number of new mandates for the NOAA, regional fishery management councils, and other Federal agencies to identify and protect important marine and anadromous fish habitat. The Councils, with assistance from NOAA, are required to delineate "essential fish habitat" (EFH) for all managed species. The Act defines EFH as "… those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NOAA regarding the potential effects of their actions on EFH, and respond in writing to the fishery service's recommendations. For the Pacific region, EFH has been identified for a total of 89 species covered by three fishery management plans (FMPs) under the auspices of the Pacific Fishery Management Council.

State Acts

California Endangered Species Act of 1984

This act provides for the recognition and protection of rare, threatened, and endangered species of plants and animals.

California Coastal Act of 1976 as Amended 1983

The California Coastal Act provides various levels of protection for areas of special concern through designations of marine life refuges, reserves, ecological reserves, and areas of special biological significance.

Oil Spill Prevention and Response Act of 1990

The Oil Spill Prevention and Response Act of 1990 (SB 2040) requires that aState oil spill contingency plan be established with a specific component to include a marine oil spill contingency planning element.

California Wetlands Conservation Policy (California Executive Order W-59-93)

This State policy recognizes the value of marshlands and other wetlands. The policy states that there be no net loss of wetland acreage and a long-term gain in the quantity, quality, and permanence of wetland acreages and values in California.

McAteer-Petris Act

This act established the San Francisco Bay Plan for the protection of the Bay and its natural resources and the development of the Bay and shoreline to their highest potential with a minimum of Bay fill. This Act established the San Francisco BCDC as the agency responsible for maintaining and carrying out the provisions of the Act. The Act directs the BCDC to exercise its authority to issue or deny permit applications for placing or extracting materials, or changing the use of any land, water, or structure within the area of its jurisdiction, in conformity with the provisions and policies of both the McAteer-Petris Act and the San Francisco Bay Plan.

California Ballast Water Management for Control of Nonindigenous Species Act of 1999 (AB 703) and The California Marine Invasive Species Act of 2003.

The 1999 Act required vessels to employ prescribed ballast water management practices to reduce the uptake and release of nonindigenous species into State waters. The bill required the CSLC to take samples of ballast water and sediment and to take other action to assess the compliance of any vessel with the prescribed requirements.

The California Marine Invasive Species Act (MISA) of 2003, (Public Resources Code sections 71200 through 71271), which became effective January 1, 2004, revised and expanded the Ballast Water Management for Control of Nonindigenous Species Act of 1999. The MISA specifies mandatory mid-ocean exchange or retention of all ballast water for vessels carrying ballast water into California waters after operating outside the US EEZ. For vessels coming from other west coast ports, the act requires minimization of ballast water discharges in state. Beginning March 22, 2006, all vessels operating within the Pacific Coast Region will be required to manage ballast water. Management options include retention of all ballast water, exchange of ballast water in near-coastal waters, before entering the waters of the state, if that ballast water has been taken on in a port or place or within the Pacific Coast region. All vessels are required to complete and submit a ballast water reporting form, maintain a vessel-specific ballast water management plan and ballast tank log book, remit the necessary fee to the Board of Equalization, and submit to compliance verification inspections.

California Clean Coast Act (SB 771)

The California Clean Coast Act (SB 771) went into effect January 1, 2006, and has several requirements to reduce pollution of California waters from large vessels. The California Clean Coast Act prohibits the operation of shipboard incinerators within 3 miles of the California coast, prohibits the discharge of hazardous wastes, other wastes or oily bilgewater into California waters or a marine sanctuary, prohibits the discharge of graywater and sewage into California waters from vessels with sufficient holding tank capacity, requires reports of discharges to the California State Water Resources Board, and submission of an information report to the California State Lands Commission.

4.3.3 Impact Significance Criteria

An impact to biological resources was considered significant if:

- Any part of the population of a threatened, endangered, or candidate species is directly affected or if its habitat is lost or disturbed. Any loss of designated or proposed critical habitat for a listed species would be a significant adverse impact.

- If a net loss occurs in the functional habitat value of a sensitive biological habitat, including salt, freshwater, or brackish marsh; major marine mammal haul out or breeding area; eelgrass, major seabird rookery; or Area of Special Biological Significance.

- If the movement or migration of fish or wildlife is substantially impeded. Substantial impedance would include preventing or severely restricting passage over an area of at least several hundred feet for a period of a week or more.

- If a substantial loss occurs in the population or habitat of any native fish, wildlife, or vegetation, or if there is an overall loss of biological diversity. Substantial is defined as any change that could be detected over natural variability.

4.3.4 Impacts Analysis and Mitigation Measures

4.3.4.1 Long Wharf Routine Operations and Potential for Accident Conditions

Impact BIO-1: Disturbance to Fishes, Birds and Mammals from Vessel Traffic Movements

Ship traffic associated with Long Wharf operations represents an incremental amount compared to the background noise of ship traffic in San Francisco Bay and along outer coast tanker routes, thus disturbance to fishes from routine operations at the Long Wharf are adverse, but less than significant impacts (Class III). Birds local to the Long Wharf have adapted to vessel traffic, and impacts are adverse, but less than significant (Class III).

Fishes could be affected by routine operations at the Long Wharf, such as noise and disturbance from ship traffic traversing to and from the Long Wharf, maintenance dredging, by the introduction of invasive species in ballast water, and by chronic inputs of pollutants. Suzuki et al. (1980) have reported studies showing that ship noise can affect fish behavior. These investigators believed that the sounds produced by large or high-speed vessels could frighten fish schools or cause them to change their migration routes. Studies have also been done which suggest that the noises produced by fishing vessels and by underwater construction causes avoidance behavior in fishes (Myrberg 1990). Other studies have shown only slight avoidance behavior by fishes in response to ship noise (Freon et al. 1990; Neproshin 1978). Scientific SCUBA divers on Naples Reef in Santa Barbara have noticed that fishes scatter briefly as oil boats pass over the reef (personal communication, Ebeling 1985). Because ship noise represents a temporary disturbance and the ship traffic associated with operations at the Long Wharf represents an incremental amount compared to the background noise of ship traffic in San Francisco Bay and along outer coast tanker routes, noise and disturbance to fishes from routine operations at the Long Wharf are expected to be adverse, but less than significant impacts (Class III).

Seabirds, shorebirds, and waterfowl are common near the Long Wharf but, with the exception of double-crested cormorants, not abundant. Approximately three pairs of western gulls nest on the Long Wharf, pelicans may roost on the Long Wharf, and double-crested cormorants and western gulls nest on the Richmond-San Rafael Bridge near the Long Wharf. Shorebirds occur nearby, and a few ducks may rest on the water adjacent to the Long Wharf. To some extent, noise and activities from normal operation of the Long Wharf may contribute to the sparse abundance of waterfowl. However, the effect is not so great that birds completely avoid the area. A more plausible explanation is that birds preferentially select habitat elsewhere that provides more shelter, roosting or nesting sites, and greater access to food resources. Seabirds, shorebirds, and waterfowl are not habitat-limited in the San Francisco Bay estuary, and noise and activities at the Long Wharf do not appear to deprive birds of important habitat. The double-crested cormorant colony on the Richmond-San Rafael Bridge is one of the largest in coastal California (Carter et al. 1992). Stenzel et al. (1991) studied this colony between 1988 and 1990 specifically to determine if there were indications that Chevron operations might be having a deleterious effect on the colony. The study results showed that the mean number of chicks fledged by the cormorants on the Bridge was similar to other colonies, that nesting success was greater than that of a reference colony on the Farallon Islands, and that the Bridge colony increased during the study while the reference colony on the Farallon Islands declined. The investigators concluded that there was no evidence that the cormorant colony on the Richmond-San Rafael Bridge was experiencing any deleterious effects. In fact, this colony continued to increase in recent years (San Francisco Estuary Project 1997, Rauzon 2000) although it experienced a decline in 2005 (Elliot, PRBO, pers. comm. 2005). Therefore, disturbance to birds from operations at the Long Wharf is judged to be adverse, but less than significant (Class III).

The possibility exists for injury or death of marine mammals due to collisions with vessels. If impacts occurred, they would be significant because all species are protected under the Marine Mammal Protection Act of 1972. Within the Bays, the marine mammal fauna typically include only harbor seals, California sea lions, and harbor porpoises. Off the outer coast, the fauna (other than species listed as threatened or endangered) also includes fur seals, elephant seals, Dall’s porpoise, and three species of dolphins. Although collision of ships with whales is documented (see below), injury or death of the smaller, fast swimming marine mammal species rarely occur. Because of the remote chance of occurrence, the potential impacts of collision with nonlisted marine mammals from Chevron vessel traffic would be adverse, but less than significant (Class III).

Harbor seals haul out at Castro Rocks and Red Rock near the Long Wharf. The fact that a large number of harbor seals have been hauling out regularly at Castro Rocks near the Long Wharf for many years suggests that regular Long Wharf operations are not interfering substantially with the activities of this species. Noise and activities produced by continued operation of the Long Wharf would not result in loss of existing habitat and constitute an adverse, but less than significant impact on harbor seals (Class III). California sea lions are much more tolerant of human activity, frequently hauling out on breakwaters, piers, and docks; disturbance from Chevron activities would produce an adverse, but less than significant impact (Class III).

California brown pelicans (federal endangered, State endangered), which use the Bays in late summer and fall, are expected to forage and sometimes roost in the vicinity of the Long Wharf. Any pelicans roosting near the Long Wharf are expected to be accustomed to noise and activity resulting from routine operations; any impacts would be adverse, but less than significant (Class III).

Several birds listed as California Species of Special Concern may occasionally be seen in the area. These include the double-crested cormorant, the long-billed curlew, the California gull, the fulvous whistling duck, and the Barrow's goldeneye; several species of foraging raptors (order Falconiformes); the black swift; and several species of passerines (perching birds of the order Passeriformes). Any impacts of routine operations on these species would consist of minor disturbance and slight degradation of water quality. Impacts to the large double-crested cormorant colony on the Richmond-San Rafael Bridge were discussed above in the Birds section. Impacts to bird Species of Concern would be adverse, but less than significant (Class III).

Tanker traffic produces a risk of collision of vessels with whales. A few incidences of collisions of vessels with whales have been reported on the West Coast (Carretta et al. 2004). Whales infrequently wander into the Bays and, therefore, the risk of death or injury from Chevron tankers within the Bay is negligible. However, the potential for collisions definitely exists along the outer coast, especially in the Gulf of the Farallones, due to the heavy ship traffic. The likelihood of collisions would be greatest during the late summer and fall, when humpback and blue whales are numerous, and during the winter and early spring as many gray whales migrate through the area. Some observations have been made of bowhead whales changing direction in response to approaching ships (Richardson et al. 1985); other whales also may actively avoid ships, thereby reducing the chance of contact.

Despite the potential for impacts, injury or mortality of whales from collisions is a very low probability event. This low probability of impact was stated in a Biological Opinion rendered by the NMFS in Section 7 Consultation under the Endangered Species Act for oil and gas development of the Santa Ynez Unit offshore Santa Barbara (NMFS 1984). Because of the low probability, the NMFS concluded that additional tanker activity, even in waters already subject to heavy traffic, is not expected to produce a significant impact on endangered whales. Consistent with this opinion, it is determined that the potential for collision of ships with whales constitutes an adverse, but less than significant impact (Class III) due to the very low probability of occurrence and the few individuals that potentially could be affected.

<u>BIO-1: No mitigation is required.</u>

Impact BIO-2: Sediment Disturbance to Benthic Habitat from Vessel Maneuvers

The area near the Long Wharf berth where propeller wash and bow thrusters may disturb sediments is very small compared to the amount of benthic habitat in the project area, and impacts of tanker sediment turbulence on benthic communities are adverse, but less than significant (Class III).

When large ships, such as oil tankers, enter shallow water, the turbulence created by their hull and propellers can disturb the sediment in their path. Organisms living in or on the sediment could be displaced by the turbulence. The benthic environment of the ship channels is an unstable one of shifting sand (Entrix 1987). The benthic community that lives in this environment has very low diversity and is comprised of organisms adapted to this unstable environment. SAIC noted in a 1996 survey that stations within navigation channels near the Point Molate fuel pier had low infaunal abundance (USACE and Contra Costa County 1997). They attributed the scarcity of infauna to the effects of propeller wash. Because the navigation channels used by the tankers visiting the Long Wharf are the same as those used by a great number of ships visiting various ports in the Bay, the sparse infauna that characterizes these channels would be the same without the impact of the tankers traveling to and from the Long Wharf. Impacts of tanker turbulence on benthic communities are expected to be adverse, but less than significant (Class III). Chevron tankers would contribute to cumulative effects.

<u>BIO-2: No mitigation is required.</u>

Impact BIO-3: Maintenance Dredging

Loss of juvenile Dungeness crabs and young Chinook salmon would be a significant, adverse impact because dredging at the time when juveniles are moving through the area could disrupt the migration patterns of these species (Class II). Because of the low volume of material dredged, adverse, but less than significant impacts (Class III) occur to plankton, other benthos, other fishes, and birds.

Dredging can affect plankton in the vicinity of these operations from turbidity generated by resuspension of sediments and from the resuspension of any pollutants associated with those sediments. Turbidity can have a number of adverse effects on planktonic organisms. Turbidity can affect plankton populations by lowering the light available for phytoplankton photosynthesis and by clogging the filter-feeding mechanisms and respiratory organs of zooplankton. The sediment at the Long Wharf is comprised almost entirely of silt and clay-sized particles. Fine sediments suspended by dredging operations can stay suspended for several hours and can create plumes for a distance of several thousand feet down current of the dredging site. Similar plumes are expected if the sediment is discharged to an aquatic disposal site. Sediment from previous dredging operations at the Long Wharf has been discharged at the Alcatraz dredged material disposal site. For this analysis, it was assumed that future dredging operations at the Long Wharf would discharge material to that site.

Sediments at the Long Wharf have been shown to have relatively low toxicity. Therefore, minimal impacts to planktonic organisms are expected from the limited duration that the sediments would be in the water column. Previous studies of dredging operations have determined that water column effects of dredging are rarely a pathway of concern (USACE, EPA, BCDC, SF-RWQCB, and SWRCB 1998). The phytoplankton and zooplankton communities of the Central Bay are similar to the open ocean. If localized impacts do occur during dredging, recruitment from ocean waters is expected to occur rapidly. The impacts of maintenance dredging at the Long Wharf on plankton would be adverse, but less than significant (Class III).

Annual maintenance dredging at the Long Wharf would displace the organisms living within the dredged sediments. Benthic organisms in sediments adjacent to the dredge area may be buried by suspended sediments or may be subjected to sublethal effects of turbidity such as interference with feeding and breathing mechanisms. A study of the effects of dredging on benthic organisms at a dredging site near Mare Island in northeast San Pablo Bay showed that the density of benthic organisms was greatly reduced in the area that was dredged annually compared to an undredged area (DiSalvo 1977). Annual dredging at the Long Wharf is expected to decrease the density and diversity in the dredged areas compared to what the infaunal community would be if the area were not dredged. However, the dominant species are expected to be similar. Infaunal assemblages north of the Long Wharf are dominated by the amphipod *Ampelisca abdita* and the Asian clam *Potamocorbula amurensis* (USACE and Contra Costa County 1997). If a lease were not granted for continued operations at the Long Wharf, the sediment in the vicinity of the Long Wharf would not be disturbed by annual maintenance dredging or by the draft and propeller wash of vessels visiting the Long Wharf. It can be assumed that a more diverse and abundant infaunal community similar to that reported by Thompson et al. (1999) and USACE and Contra Costa County (1997) for northeast Central Bay would develop. Because the amount of bottom surrounding the Long Wharf is a small percentage of the soft bottom area of Central Bay, the impacts of maintenance dredging and propeller wash at the Long Wharf on infaunal organisms would be adverse, but less than significant (Class III).

Epifaunal benthic species of concern in the vicinity of the Long Wharf include grass shrimp and Dungeness crabs. Maintenance dredging would disturb individuals of these species within the dredging area. Some individuals may be collected by the dredge; others would leave the area. Because dredging occurs in a limited area and only once a year, the impacts on grass shrimp would be adverse, but less than significant (Class III). However, juvenile Dungeness crab are common in Central Bay; particularly in late spring, and could easily be entrained by the dredge (USACE, EPA, BCDC, SF-RWQCB, and SWRCB 1998). Loss of juvenile Dungeness crabs would be a significant, adverse impact because dredging at the time when juveniles are moving through the area could disrupt the migration patterns of the species (Class II). The impact could be mitigated to less than significant by avoiding dredging during May and June.

Eelgrass, which grows along the shore in the vicinity of the Long Wharf, is another species of concern. Eelgrass needs high light levels to be successful. It is possible that turbidity generated during dredging could reduce the amount of area occupied by eelgrass by lowering light levels. Because maintenance dredging only occurs for a few weeks once per year and because eelgrass grows along the shoreline in appropriate depths almost up to the Long Wharf, it is unlikely that maintenance dredging has had a significant, adverse impact on eelgrass. Therefore, the effect of maintenance dredging at the Long Wharf on eelgrass is determined to be adverse, but less than significant (Class III).

It was assumed that disposal of the dredged sediments would be at the Alcatraz dredge disposal site. Benthic organisms in the disposal area would be buried by the dredge spoils. Organisms in adjacent areas would be subjected to turbidity. At the Alcatraz site, impacts to benthic communities have been identified not only within the disposal area, where large mounds have formed, but also at a distance of 2,000 feet from the site (Segar 1988; USACE, EPA, BCDC, SF-RWQCB, and SWRCB 1998). Furthermore, anecdotal evidence suggests that hard bottom intertidal organisms along the shores of Alcatraz Island are sometimes contacted by the disposal plumes (USACE, EPA, BCDC, SF-RWQCB, and SWRCB 1998). The in-Bay disposal site target for the Alcatraz site is 4 mcy with a 1.0 mcy monthly maximum in October-April and a 0.3 mcy in May-September (USACE, USEPA, BCDC, and SFBRWQCB 2001). The annual dredging of about 350,000 cubic yards from the Long Wharf represents about 9 percent of the annual volume of sediments discharged at the site. The impacts to benthic communities from Chevron's dredging alone would be adverse, but less than significant (Class III). The cumulative disposal of sediments at the Alcatraz site has resulted in substantial degradation of benthic communities at the site, although the current limitations on discharge volumes should reduce those impacts in the future. Cumulative impacts are discussed in Section 4.3.5, Impacts of Alternatives.

Fishes can be harmed or disturbed by turbidity from annual maintenance dredging at the Long Wharf. Fishes rarely become entrained by the dredge itself but may be exposed to high levels of suspended sediments (Herbold et al. 1992). Fishes exposed to suspended sediments in the laboratory have been shown to suffer mortality as well as sublethal signs of stress (Soule and Oguri 1976; O'Conner et al. 1977; Neuman et al. 1982). Most fishes, however, will simply avoid the dredge and disposal areas during these operations. Dredged material disposal at the Alcatraz disposal site in Central Bay does not appear to cause mortality in fishes but has been observed to affect the movement of fish schools (Monroe and Kelly 1992). In a study of fish behavior at the Alcatraz disposal site, northern anchovy, white croaker, and shiner perch were observed to move away from the site immediately following a disposal event but returned within 1 to 2 hours (O'Conner 1991). Because dredging at the Long Wharf would only occur once a year and the amount of material dredged would be relatively small, the impacts of maintenance dredging on fishes are expected to be adverse, but less than significant (Class III).

One particular concern related to maintenance dredging is that increased turbidity can disrupt Pacific herring spawning activities or reduce the survival of herring eggs, which are attached to hard surfaces and eelgrass blades along the Central Bay shoreline

(USACE, EPA, BCDC, SF-RWQCB, and SWRCB 1998). Herring spawning areas are located in the immediate vicinity of the Long Wharf, including the Long Wharf itself and near the Alcatraz disposal site. Dredging and disposal are likely to have some impact on herring eggs within the local area of the activities. Adverse effects on eggs or early larval forms could result from either the physical or chemical nature of the sediments that become suspended, including interference with attachment, fertilization, or respiration (Lebednik 2004). Because the location of herring spawning within the Bay varies from year to year, there is the chance that dredging at the Long Wharf could adversely effect a significant portion of the herring spawning success if dredging occurred in a year when major spawning activity occurred in the vicinity of the Long Wharf. The loss of a substantial portion of a year class of Pacific herring in the Bay is considered a significant adverse impact (Class II). This impact could be mitigated to insignificant by avoiding dredging during the herring spawning season of December through February and into March.

Another particular concern of dredging is that juvenile Chinook salmon could become entrained by the dredge or severely stressed by exposure to turbidity plumes. Impacts to Chinook salmon are addressed in the Rare/ Threatened/Endangered Species section.

Rare, threatened, or endangered species that occur in the vicinity of the Long Wharf include the winter run of the Chinook salmon (federal endangered, State endangered), the spring run of the Chinook salmon (federal threatened, State threatened), and the California brown pelican (federal and State endangered). Chinook salmon may be disturbed during maintenance dredging, primarily due to turbidity, although there is some potential that juvenile salmon could be entrained by the dredge. Juvenile salmon have been found to be entrained by dredges in low numbers in studies in Canada and Washington (Lebednik 2004). Turbidity during dredging is expected to occur only in the immediate vicinity of the dredging activity. However, because young Chinook salmon are known to occur in the vicinity of the Long Wharf and because the winter and spring runs are so reduced, the impacts of maintenance dredging would be potentially significant (Class II). Impacts could be reduced to less than significant by conducting dredging in June through November, when winter and spring run smolt activity is lowest.

Longfin smelt, a Federal and State Species of Concern, are common in the vicinity of the Long Wharf. They could be disturbed by maintenance dredging activities. Because longfin smelt are broadly distributed throughout the Bay, and because populations have rebounded since the end of the drought, the limited disturbance of maintenance dredging is considered to be an adverse, but less than significant impact (Class III).

The impacts to biological resources of enlarging Berth No. 4 would be similar to the impacts of maintenance dredging discussed for routine operations. Dredging the sediments to widen the berth would subject organisms to temporary localized turbidity in the vicinity of Berth No. 4 as well as at the disposal site. In general these impacts are adverse, but less than significant (Class III). However, if dredging occurred during the most sensitive periods, impacts to juvenile Dungeness crab, Pacific Herring and Chinook salmon have the potential to be significant (Class II).

<u>Mitigation Measures for BIO-3</u>:

BIO-3a. The Long Wharf shall schedule dredging to avoid the months of May and June when juvenile Dungeness crabs are most abundant in the Project area.

In the event that, due to circumstances beyond lessee's control, dredging must occur in May and June to maintain a depth for safe navigation and operation of the terminal, lessee shall consult with the California Department of Fish and Game (CDFG) regarding the potential effects of such dredging on juvenile Dungeness Crabs and Chinook salmon smolts. Such consultation may occur directly with CDFG personnel in Region 3 or with CDFG personnel during the consideration of lessee's application to the Dredged Material Management Office (DMMO). If the CDFG concurs with dredging as proposed by the lessee, documentation of which shall be provided to Lessor, it shall be conclusively presumed that juvenile Dungeness Crabs and Chinook salmon smolts will not be significantly affected, and dredging may proceed as provided herein.

BIO-3b. To avoid impacts to Pacific herring reproduction, the Long Wharf shall schedule dredging to avoid the herring spawning season of December through February and into March.

BIO-3c. Although chances of entrainment of salmon is relatively low, to protect the salmon, the Long Wharf shall schedule dredging in June through November when winter and spring run Chinook salmon smolt activity is lowest.

<u>Rationale for Mitigation</u>: Avoidance of the times of the year when Dungeness crab, Pacific herring spawning and Chinook salmon smolt are present would reduce impacts to less than significant. These dredging windows are consistent with those of the Management Plan for the LTMS Placement of Dredged Material in the San Francisco Bay Region (USACE, USEPA, BCDC, SFBRWQCB 2001). If dredging cannot be conducted during the required dredging windows then Chevron shall consult with the resource agencies as required by the LTMS Management Plan. Impacts would be reduced to less than significant.

Impact BIO-4: Introduction of Non-Indigenous Species

Invasive organisms/introduction of non-indigenous species in ballast water released in the Bay could have significant (Class I) impacts to plankton, benthos, fishes, and birds.

Ballast water from segregated ballast tanks may be discharged from vessels to San Francisco Bay as vessels take on product from the Refinery or during transfer of product from a larger vessel to a smaller vessel or barge at Anchorage No. 9. Segregated ballast water is expected to be relatively free of chemical pollutants, but the ballast water may harbor exotic species that upon release may cause problems in the estuary's ecosystem. Tankers servicing the Long Wharf comply with California's Marine Invasive Species Act. California's Marine Invasive Species Act prohibits vessels entering California water after operating outside the United States Exclusive Economic Zone (EEZ) from discharging ballast water into State waters unless the vessel has carried out a mid-ocean ballast water exchange procedure, or is using an environmentally sound alternative shipboard treatment technology approved by the CSLC. Qualifying vessels must report the time and place ballast water was taken on and released during the voyage. Vessels docking at the Long Wharf comply with these requirements. (D. Kinkela, Chevron, pers. comm. 2005). Every ship entering State waters is required to submit a ballast exchange plan, including the co-ordinates of the location where ballast exchange takes place. Beginning March 22, 2006, vessels operating within the Pacific Coast Region will be required to manage ballast water by exchanging ballast water in near-coastal water before entering state waters, retaining all ballast water on board, using an approved, environmentally-sound treatment method, or discharging to an approved reception facility.

Mid-ocean exchange of ballast water is considered an interim measure to reduce the introduction of exotic species until effective treatment technologies are developed (Falkner 2003). Mid-ocean exchange reduces the introduction of exotic species but is not completely effective. One study of the ballast water of ships that had conducted mid-ocean exchange showed that ships that exchanged ballast water had 5 percent of the number of organisms and half the number of species compared to ships that did not exchange (Cohen 1998). Therefore, mid-ocean exchange of ballast water is not completely effective at preventing the introduction of exotic species.

Exotic organisms have had a devastating effect on almost all components of the estuary ecosystem (Carlton 1979; Cohen 1998). For example, the Asian clam *Potamocorbula amurensis*, thought to have been introduced in ballast water, has depleted phytoplankton populations in Suisun Bay by its intensive feeding (San Francisco Estuary Project 1997). Furthermore, introduced zooplankton species such as *Sinocalanus doerri* and *Pseudodiaptomus forbesi* appear to have outcompeted native species in Suisun Bay and the western Delta (Herbold et al. 1991). If a foreign species were introduced that could flourish in the Bay, impacts to the existing planktonic communities could be significant (Class I).

Introduction of exotic species, including the Asian clam *Potamocorbula amurensis* introduced in 1986, has had a profound effect on the benthic community of the estuary. Almost all of the dominant benthic invertebrate species in San Francisco estuary are introduced. As discussed in existing conditions, the rate of invasions is increasing. The recently introduced green crab, for example, could affect benthic communities by preying on bivalves and outcompeting Dungeness crabs. Invasive organisms in ballast water could have a significant impact to the benthic community (Class I). In addition to the introduction of invasive non-native species in ballast water, exotic fouling organisms can be introduced to San Francisco Bay by fouling on ship's hulls. Many species are thought to have been introduced to San Francisco Bay via ships' hulls (Carlton 2001). The phasing out of tributyltin based paints to control ship fouling may increase the introduction of fouling species transported on vessel hulls. The introduction of exotic species to San Francisco Bay via ship traffic has not only devastated the San Francisco Bay ecosystem, it has resulted in the spread of exotic species to other areas of the west coast (Wasson et al. 2001). For example, San Francisco Bay is suspected of being an important source of introduction of exotic species to Elkhorn Slough (Wasson et al. 2001). The Australian reef-forming tubeworm (*Ficopomatus enigmaticus*), the European green crab, and the western Pacific tortellini snail (*Philine auriformis*) all invaded San Francisco Bay, probably via international ship traffic, before spreading along the California coast.

The introduction of non-indigenous species in ballast water discharges or by hull fouling could have a number of adverse effects on fish populations in San Francisco Bay. The eggs, larvae, or adults of non-native fishes may be present in ballast water discharges. Non-native species compete with native fishes. In addition, non-indigenous aquatic species such as the Asian clam tend to destabilize food webs. Asian clams feed voraciously at multiple levels in the food chain, ultimately reducing the food available for fishes (Cohen and Carlton 1995). Non-native species are implicated as one of the reasons for the recent declines in the populations of Delta smelt and other fish species (Bay Institute 2005). Furthermore, because of the ability of Asian clams to filter large volumes of water, this species tends to concentrate pollutants such as selenium and organotins in its tissues (Periera et al. 1999). Fishes that feed on the Asian clam have the potential to ingest large quantities of toxins. Finally, ballast water may introduce harmful algae. Harmful algal blooms have caused fish kills in a number of places (Committee on Environment and Natural Resources 2000). Introduction of non-indigenous species has the potential to have a significant adverse impact on fishes (Class I).

The introduction of non-indigenous species by ballast water discharges or hull fouling could have adverse effects on bird populations in San Francisco Bay. Some waterfowl, especially diving ducks, consume large numbers of Asian clams. Because they filter large amounts of water, Asian clams may have high concentrations of contaminants in their tissues (Pereira et al. 1999). Birds that feed on this species thus may ingest large quantities of such harmful substances as selenium. In addition, toxic algae may be introduced in ballast water discharges. For example, more than 100 cormorants and California brown pelicans died in Monterey Bay in 1991 from domoic acid poisoning produced by the diatom *Pseudo-nitzchia* (Committee on Environment and Natural Resources 2000). The introduction of non-indigenous species from operations at the Long Wharf has the potential to have a significant adverse impact on water-associated birds in San Francisco Bay (Class I).

Introduction of non-indigenous species in ballast water discharges associated with the Long Wharf could have adverse effects on marine mammals. For example, marine mammals have been killed by toxins associated with harmful algal blooms. Over 400 California sea lions died during a 1998 *Pseudo-nitzchia* bloom off Monterey (Committee on Environment and Natural Resources 2000).

Sensitive species have the potential to be adversely affected by the introduction of non-indigenous species introduced through ballast water discharges or hull fouling. As discussed in the preceding sections, potential adverse impacts include direct competition, destabilization of aquatic food webs, exposure to toxins concentrated in the tissues of the filter-feeding Asian clam, and exposure to disease organisms or harmful algae. The impacts of non-indigenous species that may be introduced from operations at the Long Wharf on sensitive species is potentially significant (Class I).

Tankers servicing the Long Wharf do not discharge unsegregated ballast water to the Bay. Unsegregated ballast water may be sent to the Chevron wastewater treatment facility. Non-segregated ballast water that is sent to the treatment facility may include nonindigenous organisms. Treatment at the facility does not include any specific procedures to prevent organisms that may be in ballast water from being discharged to Bay waters. Furthermore, the NPDES permit for the discharge does not include limitations on the discharge of organisms or requirements for monitoring of organisms. Filtration of process water at the Chevron facility would prevent the introduction of larger organisms. However, the potential exists for harmful microorganisms such as viruses, bacteria, and toxic algae to be discharged. Chevron indicates that it has not received non-segregated ballast water at its treatment facilities for several years (Kinkela, Chevron, pers. comm. 2005). Discharge of harmful microorganisms would be a significant adverse impact (Class II).

<u>Mitigation Measures for BIO-4</u>:

BIO-4. Implement MM WQ-2, in Water Quality, that requires that Chevron comply with the California Marine Invasive Species Control Act and related California State Lands Commission requirements and the Ballast Water Management for Control of Non-Indigenous Species Act and fill out a questionnaire to enable the CSLC to better track the management of ballast water. Implement Mitigation Measure WQ-5 requiring segregated ballast water be unloaded to a suitable waste handling vehicle and disposed of at an appropriate facility rather than being treated at the Chevron facility shall apply.

Rationale for Mitigation: As per MM WQ-2, Chevron has no facilities to treat segregated ballast water and it may not be economically feasible to construct a system for treating ballast water to remove exotic species. Furthermore, effective systems for the treatment of ballast water to remove all associated organisms have not yet been developed. The measure provides an interim tracking mechanism until a feasible system to kill organisms in ballast water is developed. Until an effective treatment system is developed, the discharge of ballast water to San Francisco Bay will remain a significant adverse impact. Mid-ocean exchange reduces the introduction of exotic species but is not completely effective. As per MM WQ-5, handling of non-segregated ballast water at the Refinery apparently is a relatively rare event. Therefore, transport of non-segregated ballast water to an appropriate disposal facility during the rare occasions when it is necessary to receive such water at the Long Wharf should be feasible.

Disposal of non-segregated ballast water at an approved facility will eliminate the potential introduction of harmful microorganisms that may be in this water.

Residual Impacts: Until a feasible system to kill all organisms in ballast water is developed, the discharge of ballast water to San Francisco Bay will remain a significant adverse (Class I) impact.

Impact BIO-5: Contaminants Associated with Routine Operations at the Long Wharf

Contaminant inputs into the water from Long Wharf operations are low when compared to other pollutant sources in the Bay. The impacts on plankton, benthos, fishes, and birds are considered adverse, but less than significant (Class III) impacts.

Routine inputs of contaminants from the Long Wharf are low compared to other sources of pollutants in San Francisco Bay. Because the volume of these discharges is extremely low relative to receiving water, because discharges are confined to short discrete events (such as the testing of fire water), and because water movement in the vicinity of the Long Wharf is good, rapid mixing is expected to occur. Although some contaminants in Chevron's permitted discharges may exceed water quality criteria at the point of discharge, the small volume of discharges associated with the Long Wharf would result in rapid mixing and dilution, and would not expose planktonic organisms to a high enough concentration of a toxicant for a long enough period of time to have any measurable effect on a plankton population. Therefore, the impact of routine inputs of pollutants from the Long Wharf on plankton populations is expected to be adverse, but less than significant (Class III). Chemical inputs from operations at the Long Wharf, especially in stormwater runoff from the Long Wharf, will, however, contribute to significant cumulative impacts of pollutant levels in San Francisco Bay.

Chronic inputs of toxins from the Long Wharf could contribute to the pollutant body burden of benthic organisms in the vicinity of the Long Wharf. Of all the aquatic communities, the benthic community at the Long Wharf would be most susceptible to impacts from the chronic input of pollutants associated with routine operations, because many benthic organisms have low mobility and live in the sediments where pollutants accumulate. As discussed above, the chronic release of contaminants associated with routine operations at the Long Wharf is low. Analysis of sediments at the Long Wharf has found that several metals (arsenic, chromium, copper and mercury) as well as organic contaminants (including several PAH compounds) may occur at concentrations high enough to have some effect on benthic organisms sensitive to pollutants (NOAA ER-L level). Concentrations of these pollutants in most samples were within the range of ambient sediment concentrations typical of the less polluted regions of San Francisco Bay (Gandesbery et al. 1999). One metal, nickel, exceeded the level at which effects on benthic organisms are likely in the majority of the samples. However, nickel concentrations throughout San Francisco Bay exceed the ER-M screening level (Gandesberry et al. 1999). The metals with concentrations at levels high enough to affect benthic organisms may contribue to the depauperate community that would be expected around the Long Wharf due to maintenance dredging and disturbance from the movement of vessels. Although the combined effects of Chevron's dredging and contaminant inputs may be affecting the benthic invertebrate communities in the immediate vicinity of the Long Wharf, the area of impact would be localized to the immediate vicinity of the Long Wharf. The impacts to benthic organisms of chronic contaminant releases associated with routine operations at the Long Wharf would be adverse, but less than significant (Class III).

Input of pollutants from routine operations at the Long Wharf could add to the pollutant body burden of fishes in the San Francisco Bay estuary. For example, Whipple et al. (1987) have found that striped bass in the San Francisco Bay-Delta system contained relatively high levels of pollutants, especially metals and petrochemicals. Some of these pollutants showed strong correlation with poor health and condition, parasite burdens, and impaired reproduction. Studies of contaminant levels in fishes in San Francisco Bay showed that fishes collected in 1994 and 1997 had elevated levels of contaminants, including mercury, PCBs, dieldren, DDT, and chlordane (Davis et al. 1999). Similarly, in 2000 fishes in San Francisco Bay exceeded human health screening values for PCBs, dioxin toxic equivalents, mercury, dieldrin, selenium and DDTs (Greenfield et al. 2003). None of these chemicals would be expected to be associated with Long Wharf operations. With the exception of PCBs and DDT in one sample each, the concentration of these chemicals in the vicinity of the Long Wharf is within the Ambient Sediment Concentration threshhold indicative of the less polluted areas of San Francisco Bay. Furthermore, as discussed previously, inputs associated with routine operations at the Long Wharf are low and represent a small percentage of pollutant inputs in San Francisco Bay. Therefore, the impacts to fishes of chronic contamination from routine operations at the Long Wharf are considered adverse, but less than significant (Class III).

Several sources of contaminants affect the San Francisco Bay Area: urban and nonurban runoff, river inflow from agricultural lands in the Central Valley, municipal wastewater, industrial releases, dredging, and oil/chemical spills. The most significant contaminants in regard to wildlife are cadmium, copper, mercury, selenium, and silver; DDT and metabolites; PCBs; and polycyclic aromatic hydrocarbons (PAHs).

Contaminants in the San Francisco Bay estuary both reduce the abundance of food for birds and directly affect the health of populations. Diving ducks that consume mussels and clams in these waters, especially scaup, scoters, and canvasback, are known to have elevated levels of selenium, silver, copper, mercury, zinc, and cadmium. Levels of selenium and mercury exceed that known to reduce or impair reproduction (Chambers Group 1994). Caspian and Forster's terns, black-crowned night-herons, and snowy egrets have been found to have organochlorines and mercury at levels associated with impaired reproduction and thinning of egg shells (Ohlendorf et al. 1988b). Double-crested cormorant eggs collected from the Richmond-San Rafael Bridge and the San Mateo Bridge had a much higher concentration of PCBs than double-crested cormorant eggs collected from Humboldt Bay (San Francisco Estuary Project 1997). These high PCB levels were associated with various indicators of potentially adverse physiological effects in the eggs. Nevertheless, populations of double-crested cormorants in San Francisco Bay have continued to increase in recent years.

Discharges and small chronic leaks and spills associated with the Long Wharf would be below levels that would have direct impacts on birds. Effects such as soiling of feathers from minor petroleum leaks and spills would be adverse, but less than significant (Class III). The contaminants that have been of the greatest concern for birds in San Francisco Bay (selenium, mercury, DDTs, and PCBs) are not found in elevated levels in sediments near the Long Wharf; suggesting that the Long Wharf is not contributing significantly to the body burden of these contaminants in San Francisco Bay waterbirds. Pollutants in Long Wharf discharges are judged to have an adverse, but less than significant effect on birds (Class III).

<u>BIO-5: No mitigation is required.</u>

Impact BIO-6: Oil Spills at Long Wharf or Along Tanker Routes

The impacts of a spill on the biota at or near the Long Wharf have the potential to spread throughout much of San Francisco Bay. Vulnerable biota are plankton, benthos, eelgrass, fishes, marshes, birds, and mammals. Per Section 4.1, Operational Safety/Risk of Accidents, small spills at the Long Wharf (less than 50 bbls) should be able to be contained (Class II impacts). However, spills larger than 50 bbls may not be able to be contained and the Long Wharf may not have adequate boom to protect all the sensitive areas at the most risk that could be oiled within 3 hours of a spill from the Long Wharf. Impacts from large spills are considered to be significant adverse (Class I) impacts. A significant impact to

biological resources (Class I or II impact) could result from spills of crude oil or product from a vessel in transit along tanker routes either in San Francisco Bay or outer coast waters.

Approach to Impact Assessment

This assessment of oil spill impacts relied on documented biological damages to resources from historic spill events as well as computer modeling to determine the vulnerability of the biological resources within the Bay, near the Long Wharf, and along the outer coast. Impacts to biological resources from historic spills were based on the literature review in the EIR for Consideration of a New Lease for the Operation of a Crude Oil and Petroleum Product Marine Terminal at Unocal's San Francisco Refinery at Oleum (Chambers Group 1994). The range of documented impacts from historic spills on various biological resources is briefly summarized here. The Unocal EIR contains a more detailed discussion of the scientific literature on the observed effects of spills. The Unocal EIR also used computer modeling to analyze the potential impacts of spills from tankers servicing the Unocal Terminal. Because Chevron tankers are expected to use the same routes as Unocal tankers, the results of the modeling of tanker spills from the Unocal EIR are summarized here to determine the likely impact of spills along tanker routes in the Bay and along the northern part of the outer coast. For the outer coast south of San Francisco, oil spill modeling done for the GTC Gaviota Marine Terminal Final Supplemental EIR/EIS (Aspen Environmental Group 1992) is summarized.

As discussed in Section 4.1, Operational Safety/Risk of Accidents, the greatest risk of oil spills from the continuation of Long Wharf operations is at the Long Wharf itself. To determine the impact of spills at the Long Wharf and in the approach channel, oil spill modeling was conducted for this EIR. The results of oil spill models for various spills at the Long Wharf were superimposed on the distribution of sensitive biological resources to describe the likely impacts of a spill at the Long Wharf. It should be recognized that a spill from the Long Wharf or from tankers visiting the Long Wharf has the potential to impact biological resources anywhere in San Francisco Bay, as well as along the open coast outside the Golden Gate. The purpose of the oil spill models and the analysis done in this section was three-fold: (1) The models describe the range of impacts that could be expected from various spill scenarios associated with operations at the Long Wharf. These scenarios are intended to give decision makers and the public an evaluation of the range of impacts that might occur under various spill conditions. (2) The models help to identify resources most likely to be oiled by a spill associated with Long Wharf operations. Although resources anywhere in the Bay could be affected by a large enough spill under the wrong set of weather conditions, some resources are much more likely to be oiled by a Chevron spill than others. (3) The oil spill model done for this document in conjunction with Chevron's Spill Preparedness and Emergency Response Plan (Chevron 2001) are used to identify sensitive resources that could be exposed to rapid oiling from a spill at the Long Wharf. Chevron's Plan was evaluated to determine if additional mitigation measures could be implemented to better protect those resources.

General Discussion of Impacts of Oil on Biological Resources

Documented biological damage from an oil spill has ranged from little apparent damage in the Apex Galveston Bay spill (Greene 1991) to widespread and long-term damage, such as the 1969 West Falmouth spill (Sanders 1977). Some of the factors influencing the extent of damage caused by a spill are the dosage of oil, type of oil, local weather conditions, location of the spill, time of year, methods used for cleanup, and the affected area's previous exposure to oil. Other levels of concern are the possibility of food chain contamination by petroleum products and the impact of an oil spill on the structure of biological communities as a whole.

Oil spilled into the ocean gradually changes in chemical and physical makeup as it is dissipated by evaporation, dissolution and mixing, or dilution in the water column. Various fractions respond differently to these processes, and the weathered residue behaves differently from the material originally spilled. Toxicity usually tends to decrease as oil weathers.

Laboratory tests have demonstrated the toxicity of petroleum hydrocarbons for many organisms. Soluble aromatic compounds in crude oil are generally toxic to marine organisms at concentrations of 0.1 to 100 ppm. Planktonic larval stages are usually the most sensitive. Very low levels of petroleum, below 0.01 mg/L, can affect such delicate organisms as fish larvae (NRC 1985). Concentrations as low as 0.4 ppb caused premature hatching and yolk-sac endema in Pacific herring eggs exposed to weathered Alaska crude oil (NRC 2003).

Biological impacts of oil spills include lethal and sublethal effects and indirect effects resulting from habitat alteration and/or destruction or contamination of a population's food supply. Directly lethal effects may be chemical (such as poisoning by contact or ingestion) or physical (such as coating or smothering with oil). A second level of interaction is sublethal effects. Sublethal effects are those which do not kill an individual but which render it less able to compete with individuals of the same and other species.

Computer Modeling to Predict Impacts from a Spill

Computer modeling was used to analyze the relative risk of important biological resources contacting oil from a Chevron spill. Models of oil spills were used to predict whether each of the important biological resources would be at low, moderate, or high risk should an oil spill occur. These relative risks are thus conditional probabilities. The risk of a spill from Chevron operations is analyzed in Section 4.1, Operational Safety/Risk of Accidents. It should be noted that this probability is very low. Therefore, the absolute risk of any of the important biological resources being oiled as a result of Long Wharf operations is low. However, in the unlikely event that a spill were to occur, some resources would be more likely to be contacted by oil than others. This information, when combined with sensitivities and vulnerabilities to oil of biological resources, will help in designing response and contingency plans.

This section also uses modeling of oil spill scenarios to analyze the extent to which important biological resources might be contacted by oil from spills that could occur as a result of Long Wharf operations. The methodology and assumptions used for the oil spill models are described in Section 4.0, Environmental Analysis, subsection on Assessment Methodology. These models were used in conjunction with GIS mapping of important biological resources. In predicting impacts to biological resources, assumptions were made about the areas where each resource would be most vulnerable to oil. These areas are generally the preferred habitat or the most productive areas for a given resource. The subsequent analysis focuses on the risk that oil would contact these crucial areas and the percentage of these crucial areas that would be oiled from each oil spill scenario. The areas identified as most crucial for each resource are not the only areas where that resource is found. Therefore, if an identified area is not contacted by oil in oil spill scenarios, it does not mean that there would be no impacts on that particular resource. If an area identified as most important for a particular resource is not contacted by a scenario, the inference is that the majority of the population of the resource within the project area would not be contacted by oil for the modeled spill. Finally, sensitive biological resources that could be oiled within the first 24 hours of a spill are identified. Chevron's ability to rapidly protect those resources is examined to determine whether additional measures could be implemented to improve protection of resources vulnerable to rapid oiling from a spill at the Long Wharf.

Plankton

<u>Sensitivity and Vulnerability to an Oil Spill</u>

Impacts to plankton from oil pollution could range from direct lethal effects caused by high concentrations of oil in the surface layers of the water column after a major spill to a variety of sublethal effects such as decreased phytoplankton photosynthesis and abnormal feeding and behavioral patterns in zooplankton. Studies of oil spills have generally failed to document major damage to plankton, although lethal effects or severe oiling of individual zooplankton organisms in the immediate vicinity of a spill has been reported in a number of studies. Because plankton distribution and abundance are so variable in time and space, evidence of damage might be very difficult to document, even if it did occur.

Plankton populations on the outer coast are expected to have low vulnerability to an oil spill. Even if a large number of individual organisms was oiled, rapid replacement by individuals from adjacent waters is expected. In addition, the regeneration time of phytoplankton cells is rapid (9 to 12 hours) and zooplankton organisms are characterized by wide distributions, large numbers, short generation times, and high fecundity (NRC 1985). The impacts to plankton of a spill from Chevron tankers on the outer coast is expected to be adverse, but less than significant (Class III).

Within the San Francisco Bay estuary, however, it is possible that an oil spill could have more severe impacts on plankton. Because the San Francisco Bay is a semi-enclosed system, plankton might be exposed to the oil for a longer period of time than on the open coast. Furthermore, recruitment from adjoining unoiled areas might be less available. Plankton communities in San Pablo and Suisun Bays might be particularly vulnerable to an oil spill because these areas are most isolated from recruitment from open ocean plankton populations. Zooplankton species such as the copepod *Eurytrema affinis* and the opossum shrimp, *Neomysis mercedis* might be particularly susceptible to an oil spill because they have restricted distributions centered on Suisun Bay and because populations have declined substantially in recent years. The impacts to plankton of a spill within the San Francisco Bay estuary have the potential to be significant (Class I).

The most sensitive area for plankton within the San Francisco Bay estuary is in the entrapment zone where phytoplankton populations and important zooplankton species, such as the opossum shrimp, tend to concentrate. During periods of low river flow, the entrapment zone is located in the eastern part of Suisun Bay and the western Delta. During periods of high flow, it is located throughout Suisun Bay and into Carquinez Strait. Plankton populations in eastern San Pablo Bay and Suisun Bay would be more vulnerable to an oil spill than populations in Central and South Bay because recruitment from the Pacific Ocean would occur less readily in the eastern bays than it would in the Central Bay and the northern part of South Bay. Within San Pablo and Suisun Bays, phytoplankton and zooplankton populations are most abundant over the shallow areas.

<u>Impacts to Plankton from a Spill at the Long Wharf</u>

To determine the range of potential effects resulting from an oil spill at the Long Wharf, 100 randomly generated scenarios involving a 1,000-bbl spill were run. Carquinez Strait was contacted by oil in less than 15 of those spills and oiling was greater than “trace” in less than 10 of them. South-East San Pablo Bay was contacted by less than 25 of the spills, and oiling was greater than “trace” in less than 10 of them. Therefore, a spill at the Long Wharf is unlikely to significantly oil the eastern parts of San Francisco estuary where plankton is most vulnerable. Five oil spill scenarios from the Long Wharf were analyzed in detail. In four of these, the oil largely affected Central Bay and the southern portion of San Pablo Bay. In one scenario (South-East San Pablo Bay #93), the oil spread as far as the western end of Carquinez Strait where phytoplankton concentrations and sensitive zooplankton species might be in years of high Delta outflow. In summary, most spills from the Long Wharf would not contact the most vulnerable plankton areas. Plankton populations in the San Francisco estuary are not likely to suffer a significant, adverse impact from a spill at the Long Wharf. However, under certain conditions in the spring of high outflow years, significant impacts could occur (Class I).

<u>Impacts to Plankton of a Spill from Chevron Tankers</u>

Based on trajectory modeling done for the Unocal EIR, spills from tankers operating within the Bay have the greatest probability of contacting waters near the ship channels through central and northern San Francisco Bay and San Pablo Bay. The ship channels are dredged to allow sufficient clearance for tankers and are not confined by any structure. The waters of the ship channels and western Carquinez Strait have a 12 to 17.5 percent chance of medium oiling from a spill along tanker routes. The shallow waters of San Pablo Bay would have less than a 10 percent chance of medium oiling while the waters of Suisun Bay would have less than a 6 percent chance of medium oiling. The receptor mode analysis showed that if a spill occurred at Martinez, which was the easternmost segment of the tanker route analyzed in the Unocal EIR, Middle Point in Suisun Bay would have a 10.8 percent chance of contact with oil.

In summary, of the areas which are most sensitive for plankton, Suisun Bay, which has the most unique and vulnerable plankton populations and where the entrapment zone is located during years of normal rainfall, has a relatively low (less than 6 percent chance of medium or heavy oiling and about an 11 percent chance of contact with oil) chance of being affected by a tanker spill. Carquinez Strait, where the entrapment zone may be during periods of heavy outflow, has a very high risk of oiling.

Of the tanker oil spill scenarios analyzed in the Unocal EIR, one scenario, a 100,000-bbl crude oil spill near Alcatraz in March, was determined to have significant impacts to plankton. This spill would affect almost all of Central Bay and San Pablo Bay during the spring phytoplankton bloom. At this time of year of potentially high outflow, the entrapment zone could be located in western Carquinez Strait or even the east end of San Pablo Bay. This spill could have a major impact on phytoplankton populations during the year following the spill. It is possible that, particularly in San Pablo Bay, which is a considerable distance from the open ocean, plankton populations might take several years to recover. In this situation, impacts to plankton would be detectable over natural variability and would be significant (Class I).

Benthos

<u>Sensitivity and Vulnerability to an Oil Spill</u>

Most studies of oil spills have shown that rocky intertidal communities tend to suffer harmful impacts, although spills have occurred where no impacts to this habitat were observed (e.g., Chan 1987). Oil represents a physical as well as a chemical hazard, and intertidal organisms are especially vulnerable to the physical effects of oil (Percy 1982). Sessile species, such as barnacles, may be smothered, while mobile animals, such as amphipods, may be immobilized and glued to the substrate or trapped in surface slicks in tidepools. It has been hypothesized (Hancock 1977) that organisms in the upper intertidal areas where the oil dries rapidly are more apt to be affected by physical effects of oil, such as smothering, whereas organisms in the lower intertidal areas are more exposed to the chemical toxic effect of the liquid petroleum.

If an intertidal area suffers severe damage from an oil spill, it may take years for complete recovery. A study of recovery of rocky intertidal communities of central and northern California (Foster et al. 1991) suggested that the high intertidal, algal-dominated *Endocladia/Mastocarpus* community would take 1 to 6 years to recover in places where a large area had been decimated, while the midintertidal mussel bed assemblage would be likely to take more than 10 years to recover from a disturbance that affected a large area. Mussel beds have been found to trap oil and under some circumstances may allow the oil to persist for years after a spill (NRC 2003). Documented recovery times of intertidal communities from actual oil spills have varied, but have been generally consistent with the above predictions.

Sandy intertidal areas generally respond differently to oil spills than rocky intertidal shorelines (Gilfallan et al. 1995). Although less visible than impacts to rocky intertidal communities, the marine life of sandy beaches also has been documented to suffer impacts from oil spills. In contrast to the extended recovery time observed for rocky intertidal communities, sand beach communities such as those on the outer coast would recover from a spill more rapidly than rocky communities because of the mobile nature of most sandy beach species and their adaptation to the continual disturbance of shifting sands. Gundlach and Hayes (1978) predicted that recovery of a sand beach may occur within a year, depending on the extent and persistence of the oil. On the other hand, the fine-grained intertidal mudflat communities inside San Francisco Bay might retain the oil for a long time, as occurred in the 1969 West Falmouth spill (Blumer and Sass 1972). The continued presence of oil in the sediments would prevent recovery.

Compared to the readily observable impact on intertidal communities, impacts on benthic subtidal communities have been more difficult to document. This lack of documented impacts has been found both in the shallow (6.6 to 65.6 ft, 2 to 20 m) and deep (>65.6ft, 20 m) subtidal areas. However, the studies that have shown impacts have generally been of shallow water benthic habitats. Often the lack of effects on subtidal communities appears to be because oil does not sink to the bottom. For example, in shallow subtidal SCUBA diving surveys following the 1988 Nestucca spill in Gray's Harbor, Washington, no evidence of subtidal oil deposits was found, and no sediment samples contained oil and grease above detection limits (Carney and Kvitek 1990).

Most studies have failed to document negative effects of oil spills on kelp beds. However, Thom et al. (1993) found that the tissues of bull kelp, *Nereocystis luetkeana*, were damaged following direct exposure to several oil types, including intermediate fuel oil, diesel fuel, and Prudhoe Bay crude oil. Furthermore, oil can cling to kelp and cause the surrounding shoreline to be repeatedly doused by oil as happened in the 1992 Avila spill (Togstad 1993). Kelp holdfasts also can retain oil for years after a spill (NRC 2003).

Impacts of an oil spill on the intertidal and subtidal benthic communities of the outer coast could range from widespread destruction to undetectable. The habitat most likely to suffer damage from a spill from tankers along the outer coast is the rocky intertidal. Impacts of an oil spill on the intertidal zone of the outer coast would be significant (Class I).

Impacts of an outer coast oil spill on the subtidal populations of California's coast would be even more difficult to predict than those on the intertidal biota. The most severe impacts on the subtidal benthos would probably occur if oil happened to reach any of the unique subtidal populations that occur off the California coast. For example, oil could have a significant impact if it reached the populations of the hydrocoral *Allopora californica* on Cordell Bank in northern California or Farnsworth Bank of Catalina Island in southern California. This species only occurs in certain areas and does not recruit widely. Therefore, an affected population might not recover for many years. This oil spill could, in a worst case, have a significant impact (Class I) in the subtidal benthos of the open coast.

Oil is not expected to have a significant direct impact on north coast kelp beds. Even if damage did occur, as was observed to bull kelp in the *Tenyo Maru* spill in WashingtonState (Thom et al. 1993), recovery would be rapid. *Macrocystis* is extremely fast growing and *Nereocystis* is an annual. An oil spill off the open coast, then, is expected to have adverse but less than significant impacts on kelp because of the expected rapid recovery time of the kelp if damage occurred (Class III).

The impacts of an oil spill on the benthos within San Francisco Bay could well be more pervasive and long-lasting than on the outer coast because oil can become entrapped within the semi-enclosed system of the Bay and be repeatedly redistributed into the sediments. The benthos of San Francisco Bay is dominated by introduced opportunistic species that would recover rapidly from a spill. An oil spill would be likely to selectively affect more sensitive species such as amphipods, increasing the domination of hardy exotic species. Impacts to soft substrate benthos within San Francisco Bay would be most severe in intertidal mudflats where oil would wash ashore and become incorporated in the sediments. An oil spill within San Francisco Bay has the potential to cause significant impacts to the benthos (Class I). Rocky intertidal communities within the Bay might be especially vulnerable to oil spill impacts because wave action would not remove the oil the way it does along the outer coast.

The most sensitive benthic invertebrate resource that would be at risk from an oil spill in San Francisco Bay is Dungeness crab (*Cancer magister*). The juvenile stages of Dungeness crab are found throughout San Francisco Bay, but especially in San Pablo Bay. The juvenile stages of this species might be particularly vulnerable to oil. An oil spill could have significant, adverse impacts on Dungeness crab because a spill at the time when juvenile Dungeness crab are moving through San Francisco Bay would interfere with migration patterns and because a large spill could substantially affect a year class and result in a population decline (Class I).

Another marine resource within San Francisco Bay that would be particularly vulnerable to oil spill impacts is eelgrass (*Zostera marina*). Many studies on the biological impacts of oil spills have documented impacts to marine grasses. For example, eelgrass growth and reproduction appear to have been impaired by oil contamination from the Exxon Valdez spill (Holloway 1991). Impacts of an oil spill on eelgrass would be significant (Class I).

Impacts to Benthic Organisms from a Spill at the Long Wharf

The risk of sensitive benthic resources to a spill at the Long Wharf was predicted by analyzing the areas contacted by 100 randomly generated scenarios of a 1,000-bbl spill at the Long Wharf. This analysis showed that 87 percent of the spills would contact east-central Bay. About 58 percent of the spills would result in heavy oiling to this area and approximately 75 percent would result in greater than trace amounts of oil. Therefore, east-central Bay rocky features, including Red Rock, Castro Rocks, the Brothers, and Point San Pablo, would be at very high risk from a spill from the Long Wharf.

Based on the 100 randomly generated scenarios of a 1,000-bbl spill at the Long Wharf, the portion of San Francisco Bay with the second highest risk from a spill is the Brooks Island/Richmond area. About 57 percent of the randomly generated spills would contact this area. Approximately 48 percent would result in contact by greater than trace amounts of oil and about 32 percent would result in heavy oiling. Significant rocky shoreline within this area includes Brooks Island. Brooks Island, therefore, would be at high risk from a spill at the Long Wharf.

Significant rocky shoreline at Treasure Island and Yerba Buena Island in the Berkeley/Emeryville area would have a 20 percent chance of being contacted by oil from a spill at the Long Wharf and about a 10 percent chance of being contacted by greater than trace amounts of oil. The chance of rocky shore at Treasure Island and Yerba Island being contacted by heavy amounts of oil is about 5 percent. Therefore, these islands are at moderate risk from a spill at the Long Wharf. Rocky shore at Tiburon and Angel Island is also at moderate risk from a spill at the Long Wharf. The chance of oil contacting the Angel Island/Tiburon area is about 22 percent. The chance of heavy oiling of these shores is 10 percent. Significant rocky shore near the Golden Gate is at low risk from a spill at the Long Wharf. Less than 10 percent of the randomly generated oil spill scenarios contacted the Marin or San Francisco Peninsula areas and in less than 5 of the randomly generated spill scenarios was the oil greater than trace. Similarly, natural rocky shore in Richardson Bay would be at very low risk from a spill at the Long Wharf with only about a 2 percent chance of being contacted by heavy oil.

For the soft bottom benthos, assemblages in intertidal mudflat are most vulnerable to a spill within the Bay. The most extensive areas of intertidal mudflat occur along the shores of San Pablo Bay and South Bay, although some intertidal mudflat occurs in all segments except San Francisco Peninsula and Marin. Intertidal mudflat along southeast San Pablo Bay has about a 23 percent chance of being contacted by a spill from the Long Wharf and about an 8 percent chance of being contacted by anything greater than trace amounts of oil. Therefore, intertidal mudflats in southeast San Pablo Bay are at moderate risk from a spill at the Long Wharf. Based on the 100 modeled scenarios of a Long Wharf spill, the extensive intertidal mudflats in west San Pablo Bay and north San Pablo Bay have a relatively low chance of contact by oil. Mudflats in north San Pablo Bay have a 10 percent chance of contact by oil from a Long Wharf spill. Mudflats in west San Pablo Bay only have about a 2 percent chance of contact by a spill from the Long Wharf. The chance of a spill from the Long Wharf contacting the large mudflat areas in South Bay is very low. Alameda, which is north of the large South Bay mud flats, had less than a 10 percent chance of being contacted by any oil and was not contacted by heavy oil in any of the 100 scenarios.

Dungeness crabs are most abundant in the southern part of San Pablo Bay and the northern part of Central Bay. Based on the 100 modeled scenarios of a Long Wharf spill, southeast San Pablo Bay, the area that has the most consistently high number of juvenile Dungeness crab, has a moderate risk of contact by oil from a spill at the Long Wharf (23 percent chance of any contact, 8 percent chance of contact by more than trace amounts of oil). East Central Bay, which also regularly supports Dungenness crab, has a very high risk of being oiled from a spill at the Long Wharf. Seventy-five of the 100 modeled oil spill scenarios resulted in east Central Bay being contacted by greater than trace amounts of oil. Therefore, Dungeness crabs are considered to be at relatively high risk from a spill at the Long Wharf.

The eelgrass beds between Point San Pablo and Point Richmond would be at very high risk from a spill. Of the 100 modeled oil spill scenarios, 87 contacted these beds and 58 resulted in heavy oiling. Eelgrass beds in the Brooks Island/Richmond area also are at relatively high risk of being contacted by a spill at the Long Wharf. Fifty-seven of the 100 randomly generated oil spills contacted this area and 32 resulted in heavy oiling. The largest eelgrass bed north of San Pablo Point has a 23 percent chance of being contacted by oil from a spill at the Long Wharf and about an 8 percent chance of being contacted by greater than trace amounts of oil. The eelgrass bed north of San Pablo Point is thus at moderate risk from a Long Wharf spill. Other eelgrass beds at Alameda and Richardson Bay are unlikely to be contacted by a spill from the Long Wharf. These areas were contacted by oil in fewer than 10 of the 100 randomly generated spill scenarios. Oiling of these areas was greater than trace in less than 5 of the 100 modeled spills. Eelgrass beds in San Francisco Bay are at relatively high risk from a spill at the Long Wharf, but some beds are unlikely to be contacted.

Table 4.3-13 shows the percentage of hard substrate within San Francisco Bay and the significant rocky areas contacted by oil in each of the five Long Wharf spill scenarios analyzed in detail. Each of these spills resulted in oil contacting significant rocky features in Central Bay and each would be likely to result in a significant, adverse impact to rocky intertidal assemblages in San Francisco Bay (Class I). In each of the five scenarios, rocky habitat at San Pablo Point, Red Rock, Castro Rocks, and the Brothers was contacted by oil. The Brooks Island/Richmond Island (#22) (see Figure 4.3-6) and West Central Bay (#68) scenarios had the most extensive impacts to rocky intertidal features. In both of these spill scenarios, oil contacted much of the significant rocky intertidal habitat in Central Bay. In the Brooks Island/Richmond scenario (#73), oil contacted 13.7 percent of the hard substrate in the Bay. In the West Central Bay scenario (#68), oil contacted 11.8 percent of the hard substrate. In the other scenarios, oil contacted less than 10 percent of the hard substrate.

Figure 4.3-6 – Brooks Island/Richmond Oil Spread Scenario – Impacts on Nearshore Resources

Table 4.3-13
Percentage of Hard Substrate in San Francisco Bay and Significant Rocky Features Contacted by Oil in the Five Representative Scenarios of a Spill at the Long Wharf

Berkeley/ Emeryville #33	West Central Bay #68	Brooks Island/ Richmond #73	West San Pablo Bay #91	South-East San Pablo Bay #93
6.5%	11.8%	13.7%	9.0%	8.6%
San Pablo Point Red Rock Castro Rocks Brooks Island Angel Island (barely) The Brothers	San Pablo Point Red Rock Castro Rocks The Brothers Pt. San Pedro Pt. San Quentin Tiburon Angel Island (north shore)	San Pablo Point Red Rock Castro Rocks Brooks Island Angel Island The Brothers Tiburon Treasure Island Pt San Pedro Pt. San Quentin	San Pablo Point Red Rock Castro Rocks The Brothers Pt. San Pedro Pt. San Quentin	San Pablo Point Red Rock Castro Rocks The Brothers

Each of the five detailed scenarios of a Long Wharf spill contacted intertidal mudflat but none contacted more than 10 percent of the mudflat in San Francisco Bay. The percentage of mudflat contacted ranged from 2.5 percent in the Berkeley/Emeryville scenario (#33), in which most of the oil stayed in Central Bay, to 9.3 percent in the West San Pablo Bay scenario (#91), in which oil was carried into the extensive mudflats of western San Pablo Bay.

The percentage of juvenile Dungeness crab habitat contacted by oil in each of the five spill scenarios ranged from 18.5 percent in the Berkeley/Emeryville scenario (#33) to 45.9 percent in the West Central Bay scenario (#68) as shown on Figure 4.3-7. Therefore, all of the representative scenarios of spills at the Long Wharf affected a substantial percentage of habitat where juvenile Dungeness crabs are known to be abundant. A spill from the Long Wharf is likely to have a significant, adverse impact on Dungeness crabs because loss of a large number of juveniles could cause a population decline that would be detectable over natural variability (Class I).

In all of the five selected oil spill scenarios eelgrass was contacted. The Berkeley/Emeryville scenario (#33) contacted all of the eelgrass beds from San Pablo Point to Brooks Island, but avoided the large eelgrass bed north of San Pablo Point. The Berkeley/Emeryville spill resulted in about 15 percent of the eelgrass in San Francisco Bay being contacted by oil. The West Central Bay scenario (#68) did not contact beds between Point Molate and Point Castro, south of San Pablo Point, and at Brooks Island, but did contact the large bed north of San Pablo Point as well as eelgrass near the Long Wharf and along the shores near Tiburon. The West Central Bay scenario resulted in 63.8 percent of the eelgrass in San Francisco Bay being contacted with oil. The Brooks Island/Richmond scenario (#73) contacted all the eelgrass from Berkeley to Point San Pablo, including the large bed north of Point

Figure 4.3-7 – West Central Bay Oil Spread Scenario – Impacts on Juvenile Dungeness Crabs

San Pablo and eelgrass along the shores of the Tiburon Peninsula. The Brooks Island/Richmond scenario contacted 67 percent of the eelgrass in San Francisco Bay. The West San Pablo Bay scenario contacted eelgrass beds between San Pablo Point and Point Richmond, but avoided the large bed north of Point San Pablo as well as the beds off Brooks Island, Berkeley, and the Tiburon Peninsula. In the West San Pablo Bay scenario, 6.4 percent of the eelgrass in San Francisco Bay was contacted with oil. Finally, in the South-East San Pablo Bay scenario (#93), eelgrass beds between the Long Wharf and San Pablo Point (including the large bed north of San Pablo Point) were contacted by oil. Beds off Tiburon, Brooks Island, and Berkeley were avoided. In the South-East San Pablo Bay scenario, 54.7 percent of the eelgrass in San Francisco Bay was contacted by oil. Clearly a spill at the Long Wharf could have a significant, adverse impact on eelgrass (Class I). In three of the scenarios analyzed in detail, over half the eelgrass in San Francisco Bay was contacted by oil from a 1,000-bbl spill at the Long Wharf.

Impacts to Benthic Organisms of a Spill from Chevron Tankers

Table 4.3-14 shows the relative risk of sensitive benthic resources in San Francisco Bay from a spill originating from tankers servicing the Long Wharf. Such a spill would have a greater than 5 percent probability of subjecting over 50 percent of the rocky intertidal habitat in San Pablo Bay and the northern part of Central Bay to medium or greater doses of oil. The receptor mode analysis conducted for the Unocal EIR showed that Castro Rocks would have as much as a 28.5 percent chance of contact with oil from a tanker spill and Yerba Buena Island would have up to a 25.7 percent chance. Therefore, a spill from Chevron tankers poses a high risk to rocky intertidal areas in San Pablo Bay and the northern part of Central Bay. An oil spill originating from tankers would have a greater than 5 percent probability of contacting between 10 and 50 percent of the rocky intertidal habitat in the southern part of Central Bay with medium or greater quantities of oil. Therefore, tankering poses a moderate risk to the diverse rocky intertidal communities of south Central Bay. Overall, Chevron tankering poses substantial risk to the rocky intertidal communities of the San Francisco Bay estuary.

A spill from a tanker poses moderate risk to the intertidal mudflats of Carquinez Strait and San Pablo Bay. Most of the mudflats along the southern shore of San Pablo Bay and in the western end of Carquinez Strait would have a greater than 5 percent probability of being hit by medium or greater doses of oil from a spill originating from tankers servicing the Long Wharf. Chevron tankering therefore does pose substantial risk to the intertidal mudflats of these portions of the estuary but a low risk to mudflats in other areas.

Table 4.3-14
Level of Risk to Sensitive Benthic Resources in San Francisco Bay Estuary from an Oil Spill from Chevron Tankering

Resource	Relative Risk From Tankering
Rocky Habitat	H = North Central Bay, San Pablo Bay M = South Central Bay L = All other bays
Intertidal Mudflats	M = Carquinez Strait, San Pablo Bay L = All other bays
Juvenile Dungeness Crab	H = South Central Bay, San Pablo Bay M = Carquinez Strait L = All other bays
Eelgrass	H = North Central Bay M = South Central Bay, San Pablo Bay

L = Low risk - less than 5% probability of contacting more than 10% of resource.
M = Moderate risk - greater than 5% probability of contacting 10 to 50% of resource.
H = High risk - greater than 5% probability of contacting greater than 50% of resource.

Juvenile Dungeness crabs in Central Bay and San Pablo Bay would have greater than a 5 percent probability that greater than 50 percent of the areas where they are most numerous could be contacted by at least medium doses of oil from a spill originating from tankers. Juvenile crabs in these Bays would be at high risk from an oil spill from Chevron tankers. Juvenile crabs in Carquinez Strait would have a greater than 5 percent probability that between 10 and 50 percent of the area where they have been collected would be subjected to medium oiling from a tanker spill. Tankers are judged to pose a moderate risk to juvenile Dungeness crabs in Carquinez Strait. Overall, tankering poses substantial risk to juvenile Dungeness crabs.

A tanker spill would have a greater than 5 percent probability of subjecting more than 50 percent of the eelgrass in the northern part of Central Bay to medium or greater doses of oil (Chambers Group 1994). Between 10 and 50 percent of the eelgrass in southern Central Bay and San Pablo Bay would have a greater than 5 percent probability of being hit by moderate or greater doses of oil from a tanker spill. The eelgrass bed north of San Pablo Point would have between a 12 and 17.5 percent probability of being contacted by a medium or greater dose of oil (up to a 45.8 percent chance of contact with oil), but the eelgrass in South Bay would have less than a 2 percent probability of being contacted by a medium or heavy dose of oil. The eelgrass at the Alameda Naval Air Station (NAS) had up to a 4 percent chance of contact with oil in the receptor analysis run. Overall, a spill from tankering poses moderate risk to eelgrass in the San Francisco Bay estuary.

In the two 100,000-bbl oil spill scenarios from a tanker near Alcatraz modeled in the Unocal EIR, oil contacted a substantial portion of the natural rocky shore (54.6 percent and 31.2 percent), juvenile Dungeness crab (67.5 percent and 21.4 percent), and eelgrass (58.5 percent and 27.7 percent) habitat in San Francisco Bay. Oiling of intertidal mudflat was less extensive in these spill scenarios. A total of 18.2 percent of the intertidal mudflat in the Bay was contacted by oil in Scenario 9 and 8.8 percent was contacted in Scenario 10. The two modeled 1,000-bbl spills from a tanker at Anchorage 9 in South Bay contacted no natural rocky shore or eelgrass and only 2.9 percent and 1.2 percent of the Dungeness crab area. However, because of the large amount of intertidal mudflat in South Bay, the percentage of mudflat contacted in these scenarios (8.6 percent and 12.4 percent) was similar to that contacted by the much larger spill scenarios near Alcatraz.

To evaluate the relative risk to benthic resources on the outer north coast of California from tankers servicing the Long Wharf, those significant biological areas at highest relative risk (greater than a 1.5 percent probability) of medium oiling from a tanker spill were identified based on the analysis in the Unocal EIR. An oil spill from tankers traveling from San Francisco Bay would have the greatest probability of moderately oiling the shoreline between the Point Reyes area and Santa Cruz. Significant intertidal and subtidal areas in northern California most at risk include Bodega Head, Bird Rock Area of Special Biological Significance (ASBS), Point Reyes Headland, Limantour Marine Reserve, Double Point ASBS, Duxbury Reef, James V. Fitzgerald Marine Reserve and ASBS and Ano Nuevo Point. Analysis in the GTC Gaviota Marine Terminal EIR/EIS (Aspen Environmental Group 1992) showed that significant rocky habitat along the shores of the northern Channel Islands was at relatively high risk from an oil spill from tankers off central and southern California.

Fishes

Sensitivity and Vulnerability to an Oil Spill

Although major fish kills from oil spills have rarely been reported, evidence exists that oil pollution could have negative effects on all the life history stages of fishes. Malins and Hodgins (1981), in a literature review on petroleum effects on marine fishes, concluded that ample evidence existed that fishes exposed to petroleum in sediments, water, or through the diet accumulate hydrocarbons in tissues and body fluids. Laboratory studies thus have shown that the accumulation of hydrocarbons in fishes leads to a number of deleterious biological changes that can affect health and survival. Many of these effects were induced at relatively high concentrations that would be unlikely to be encountered in the marine environment. Moreover, adult fishes may be able to avoid an oiled area. There is some evidence of avoidance of hydrocarbons by fishes in the field but observations are few and circumstantial (NRC 1985). An indirect effect of oil spills on fish populations is a decrease in the invertebrate food base.

Impacts of oil spills to adult fishes have varied from windrows of dead fishes observed in the west Falmouth spill (Sanders 1977) to no apparent effect. Localized effects on fishes were observed in the Shell Martinez spill that occurred within San Francisco Bay. Fish abundance was reduced in the oiled sloughs, but no region-wide impacts on fishes were detected (Fischel and Robilliard 1991). Studies following the Martinez spill showed that individuals of the staghorn sculpin (*Leptocottus armatus*) in the vicinity of the spill had enhanced hydrocarbon metabolizing enzymes (Spies 1989). These results suggest that the spill may have had localized sublethal effects on resident fish populations.

Larval stages are sensitive to much lower concentrations of oil than those shown to affect adults. Moreover, adult fishes would be able to avoid an oiled area, but planktonic eggs and larvae would not; therefore, the egg and larval stages would be the most susceptible to adverse impacts. For example, in the 1989 spill of fuel oil from the tanker World Prodigy in Narragansett Bay, the early life stages of several fish species were observed to suffer significant impacts within the slick (Spaulding 1989).

Particularly vulnerable fish populations off the outer coast would be species that use estuaries or coastal streams for part of their early life histories. These species, which include such flatfishes as California halibut, starry flounder, and English sole, as well as anadromous species such as green and white sturgeon; American shad; pink, chum, coho, and Chinook salmon; and steelhead trout, would be especially vulnerable if the mouth of an estuary or coastal stream became fouled with oil. Impacts of an oil spill to fishes which use estuaries on coastal streams have the potential to be significant (Class I). Impacts to open ocean and coastal species would be adverse, but less than significant (Class III).

Particularly sensitive fish species within the San Francisco Bay estuary include those with a restricted distribution, such as the Delta smelt, as well as the anadromous fishes that pass through the northern reach on their way to the Delta to spawn. All these species are at particular risk not only because a large percentage of their populations might be contacted by a single oil spill, but also because their populations have been declining in recent years. The adult stages of anadromous fishes would probably be far less vulnerable to a spill than the early life stages. Adults pass quickly through the Bay on their way upstream to spawn and would be exposed to oil only briefly. Because most spilled oil is on the surface and the fishes are in the water column in the deep waters of the estuary, they would be unlikely to come into direct contact with oil. The juvenile stages of striped bass and Chinook salmon, however, tend to spend considerable time in the shallow waters of the North Bay before they pass out of the Golden Gate and into the open ocean. If oil became trapped in the shallow waters of the North Bay, young striped bass and young Chinook salmon might be particularly at risk. Potential impacts of a spill within the San Francisco Bay estuary on Delta smelt and anadromous fishes would be significant (Class I).

Fishes that spawn in the Bay also might be particularly vulnerable to an oil spill because the egg and larval stages are so sensitive to oil. Important fish species that spawn primarily in the Bay include Pacific herring, longfin smelt, yellowfin goby, plainfin midshipman, bay goby, and topsmelt. Impacts to Pacific herring, which lay thin eggs on the partially hard substrate within the estuary, would be particularly susceptible to oil and impacts of a spill in the Bay could be significant (Class I). Several studies documented lethal and sublethal effects of oil on the eggs and larvae of Pacific herring following the 1989 *Exxon Valdez* oil spill (Norcross et. al. 1996, McGurk and Brown 1996, Hose et. al. 1996). Similarly, impacts to longfin smelt, which spawn primarily in the fresh-water at the eastern end of the estuary, could be significant if oil got into this part of the estuary (Class I). Impacts to other species that spawn in the estuary would only be significant in the case of an extremely expansive slick because these species are widely distributed (Class III for most spills). Species that spawn in both the Bay and the ocean would be less vulnerable. This latter group included Pacific staghorn sculpin, jacksmelt, and northern anchovy (Class III impacts).

<u>Impacts to Fishes from a Spill at the Long Wharf</u>

The fish species that would be most vulnerable to an oil spill associated with the Long Wharf are those that have all or most of their population within the San Francisco Bay estuary and those that may have a substantial portion of their populations outside the Golden Gate but that use the Bay as an important spawning or nursery area. Declining species such as striped bass, Chinook salmon, white sturgeon, and Delta and longfin smelt are especially vulnerable to an oil spill. Pacific herring are also vulnerable because they spawn in the Bay. Species such as northern anchovy and white croaker, which are widely distributed throughout the Bay and the ocean waters outside the Golden Gate, are not considered to be at significant risk from an oil spill, although a large spill might cause a temporary reduction in abundance within the oiled areas.

In evaluating oil spill impacts on fishes, particular emphasis was placed on oiling of shallow water habitat (defined as water depth less than 6 feet). Shallow water was emphasized for two reasons. The first is that fishes, especially the sensitive younger life stages, spend more time in the rich productive shallow waters of the estuary. The second reason is that oil would be more likely to contact fishes in shallow water habitats. In the deeper waters, such as the ship channels and most of Carquinez Strait, the oil would primarily be in the surface layers and fishes might be able to swim under it with little apparent effect. Data on oil concentrations in the water column after an oil spill are consistent with this assumption. Levels of oil in the water column following major spills have been measured at between 3 and 500 ppb and have been found to return to background levels within 2 months (Gundlach et al. 1983). Lethal effects of oil on adult fishes and juveniles have generally been found only at concentrations greater than 1 ppm. Sublethal effects have been found at concentrations of 100 ppb and greater.

Shallow water fish habitat occurs along the shores of much of the San Francisco Bay estuary, except for the Alameda/Oakland Harbor area, the Golden Gate, and the wharves and docks of San Francisco Peninsula. The most extensive shallow water fish habitat is along the shores of San Pablo Bay and in South Bay. The shallow water fish habitat of San Pablo Bay, Suisun Bay, and Central Bay, in general, would be more important than that of South Bay because it supports the movements of juvenile anadramous fishes migrating from the Delta to the ocean.

The risk to shallow water fish habitat from a spill at the Long Wharf was determined by evaluating the segments of the Bay contacted by 100 scenarios of a 1,000-bbl spill. This analysis showed that shallow water fish habitat in east Central Bay was at very high risk from a spill at the Long Wharf. In 68 of the 100 spills, moderate or heavy oil contacted this area. Shallow water fish habitat in the Brooks Island/ Richmond area was also at high risk from a Long Wharf spill. In 36 of the 100 modeled spills, medium or greater doses of oil contacted this area. Shallow water fish habitat in southeast San Pablo Bay was at moderate risk from a spill at the Long Wharf. In 7 of the 100 modeled spills, medium or heavy oil contacted shallow water fish habitat in southeast San Pablo Bay. Shallow water fish habitat in west San Pablo Bay, north San Pablo Bay, west Central Bay, Richardson Bay, and South Bay was at low risk from a spill at the Long Wharf. Less than 5 of the 100 modeled spills resulted in medium or heavy doses of oil contacting these areas.

Longfin smelt are distributed throughout San Francisco Bay but are most abundant in the southeastern part of San Pablo Bay. The 100 scenarios of a spill at the Long Wharf indicated that this area was at moderate risk of being contacted by oil.

Pacific herring lay their eggs on hard substrate, mostly in Central Bay and the northern part of South Bay. Based on the 100 modeled oil spill scenarios, the risk to herring spawning habitat from a spill at the Long Wharf ranges from high for spawning areas in east Central Bay and the Brooks Island/Richmond area and moderate for Berkeley/Emeryville, Tiburon, and Angel Island, to low for Richardson Bay, west Central Bay, San Francisco Peninsula, and Alameda.

Anadromous fish species most at risk from an oil spill associated with the Long Wharf include Chinook salmon, striped bass, American shad, and white sturgeon.

The young Chinook salmon, which migrate from their birthplace in the rivers to the open ocean, would be the segment of the salmon population most vulnerable to an oil spill. During the time that the young are migrating through the waters of the northern portions of the San Francisco Bay estuary to the ocean, they may spend considerable time in the shallow waters feeding. Young Chinook salmon are particularly abundant in the shallow waters on the south side of San Pablo Bay.

The 100 modeled scenarios of a spill in the south side of San Pablo Bay from the Long Wharf indicated that this area is at moderate risk of being oiled by a spill. South-East San Pablo Bay had a 7 percent chance of being contacted by a medium or heavy dose of oil from a 1,000-bbl spill at the Long Wharf.

Striped bass are abundant throughout the northern portion of San Francisco Bay and would be most vulnerable in the shallow water habitats. As discussed above, the 100 modeled scenarios of a spill at the Long Wharf indicated that the risk to shallow water fish habitat in the northern portions of San Francisco Bay ranges from high for shallow water habitat in east Central Bay to low for north and west San Pablo Bay.

American shad are most abundant in shallow water on the north side of San Pablo Bay and in Suisun Bay. Based on the 100 modeled scenarios of a spill at the Long Wharf, these areas are at low risk from a spill at the Long Wharf.

White sturgeon are most abundant in the Honker Bay portion of Suisun Bay, but they are also common in the shallow water of San Pablo Bay. Suisun Bay is at very little risk from a spill at the Long Wharf. The 100 modeled scenarios of a Long Wharf spill indicated that the risk to shallow water habitat in San Pablo Bay ranged from low for west and north San Pablo Bay to moderate for southeast San Pablo Bay.

Table 4.3-15 shows the percentages of sensitive fish habitat contacted by each of the five modeled scenarios chosen to represent the possible range of effects from a spill at the Long Wharf. The percentage of shallow water fish habitat contacted by the spills ranged from about 5 percent for the South-East San Pablo Bay scenario (#93) to 8.7 percent for the West San Pablo Bay scenario (#91). While all of the spills contacted some shallow water fish habitat, none contacted more than 10 percent. Therefore, the impact to fishes of a spill at the Long Wharf would be adverse, but less than significant (Class III) to species that are not particularly vulnerable because of restricted distributions within San Francisco Bay.

Table 4.3-15
Percentage of Habitat Used by Sensitive Fish Species Contacted by Oil in Five Representative Scenarios of a Spill at the Long Wharf

Scenario	Berkeley/ Emeryville #33	West Central Bay #68	Brooks Island/ Richmond #73	West San Pablo Bay #91	South-East San Pablo Bay #93
Shallow Water	5.4	5.8	7.9	8.7	5.0
Salmon	11.6	31.9	29.9	0.7	78.8
Striped Bass	10.5	10.5	12.3	15.7	9.1
Pacific Herring	17.6	5.9	22.0	4.8	3.7
American Shad	0	2.4	0.4	15.3	0.7

The percentage of Pacific herring spawning areas contacted by oil in the five scenarios ranged from 3.7 percent in the South-East San Pablo Bay scenario (#93) to 22 percent in the Brooks Island/Richmond scenario (#73). Shallow water habitat and fishes affected by the Brooks Island/Richmond scenario are shown in Figures 4.3-8 and 4.3-9. Impacts to Pacific herring would probably not be significant for the scenarios that contacted less than 10 percent of the spawning area but for the two scenarios (#33 and #73) in which over 15 percent of the spawning habitat was contacted, it is possible that the impacts to Pacific herring could be substantial enough to be detected over natural variability (Class I).

Figure 4.3-8 – Brooks Island/Richmond Oil Spread Scenario – Impacts on Shallow Water Habitat

Figure 4.3-9 – Brooks Island/Richmond Oil Spread Scenario – Impacts on Fish

The percentage of the preferred habitat of juvenile Chinook salmon contacted in the five scenarios ranged from negligible in the West San Pablo Bay scenario (#91) to 78.8 percent in the South-East San Pablo Bay scenario (#93). Therefore, the impacts to Chinook salmon of a spill at the Long Wharf would depend on the direction the oil was carried. Clearly if the oil was carried into the shallow water of San Pablo Bay, the impact to Chinook salmon would be highly significant (Class I). Only the West San Pablo Bay scenario would not have a significant, adverse impact to Chinook salmon, a listed species.

The percentage of striped bass habitat contacted by a spill from the Long Wharf ranged between 9.1 percent in the South-East San Pablo Bay scenario (#93) and 15.7 percent in the West San Pablo Bay scenario (#91). These impacts would be significant if the spill occurred during the time when the juvenile striped bass were migrating out of the Delta (Class I).

Four of the five Long Wharf spill scenarios resulted in less than 2.5 percent of American shad's preferred habitat being contacted by oil. In the West San Pablo Bay scenario (#91), however, 15.3 percent of the preferred habitat of American shad was contacted by oil. Therefore, in most cases, a spill at the Long Wharf would not have a significant impact on American shad (Class III), but if oil was transported into north San Pablo Bay when young shad were migrating out of the Delta, the impact would be significant (Class I).

<u>Impacts to Fishes of a Spill from Chevron Tankers</u>

Based on the analysis of tanker spills within the Bay conducted for the Unocal EIR (Chambers Group 1994), longfin smelt, Pacific herring spawning areas, Chinook salmon, striped bass, and white sturgeon were all at moderate risk from a spill from tankers operating within the Bay. These species all had substantial portions of their preferred habitat with up to a 17.5 percent probability of contact by medium or greater doses of oil from a tanker spill within the Bay. American shad populations were determined to be at low risk. The preferred habitat for American shad on the north side of San Pablo Bay and in Suisun Bay had between a 0 and 8 percent chance of moderate oiling from a tanker spill.

Table 4.3-16 shows the percentage of preferred fish habitat contacted by the four oil spill scenarios from tankers operating within the Bay. The worst-case tanker spill analyzed, a 100,000-bbl spill from a tanker near Alcatraz (Scenario 9), resulted in a substantial portion of the preferred habitat of sensitive fish species being contacted by oil. This spill occurred under conditions that spread the oil throughout Central Bay and up into San Pablo Bay and Carquinez Strait. In Scenario 10, another 100,000-bbl spill near Alcatraz, the oil stayed within Central Bay and much lower percentages of sensitive fish habitat were contacted by oil. Two other scenarios of tanker spills (11 and 12), representing two 1,000-bbl spills from a tanker at Anchorage 9, contacted very little sensitive fish habitat. Therefore, impacts to sensitive fish resources from a tanker operating within San Francisco Bay could range from significant (Class I) to adverse, but less than significant (Class III).

Table 4.3-16
Percentage of Fish Preferred Habitat in San Francisco Bay Estuary Contacted by Tanker Oil Spill Scenarios

Fish Resource	Scenario			
	9	10	11	12
Longfin Smelt	25.0	0	0	0
Pacific Herring Spawning	50.9	52.9+	0	0
Chinook Salmon	41.6	0.8	0.8	0.8
Striped Bass	31.9	16.1	0.8	3.5
American Shad	40.7	0	0	0
White Sturgeon				
Preferred Habitat Total	43.0	0.1	0	0
Honker Bay	0	0	0	0

+ = Modeled spill would not occur during spawning season.
Source: Chambers Group 1994.

The Unocal EIR modeled two scenarios of a spill from a tanker traveling along the outer coast. Of the two oil spill scenarios modeled, Scenario 1 contacted no major salmon streams or enclosed bays, although it did contact several small streams with steelhead runs. Scenario 2 contacted the mouths of four major salmon streams: Ten Mile River, Noyo River, Big River, and Navarro River. Scenario 1, a spill at the Golden Gate, would not substantially affect outer coast fishes, while Scenario 2, a spill off the Mendocino Coast, would. These scenarios indicate that impacts to fishes from a spill from tankers traveling along the outer coast may be significant depending on the location of the spill and the weather and oceanographic conditions.

Marshes and Coastal Estuaries

Sensitivity and Vulnerability to an Oil Spill

Vegetated marshes within the San Francisco estuary and coastal estuaries along the outer coast are two of the habitats which would be most sensitive to an oil spill. In most oil spills that have contacted saltmarshes, damage has been noted to marsh vegetation (NRC 1985,2003). The margins of the sea seem to be especially susceptible to the impacts of oil spills because when a large spill drifts ashore, tidal areas often are subjected to heavy oiling. In the case of saltmarshes, oil may become incorporated into sediments where it may persist for years. Documented recovery times for oiled marshes range from a few weeks to decades (NRC 2003). Clearly any saltmarsh or coastal estuary on the outer coast or in San Francisco Bay would be likely to suffer significant impacts if it was contacted by oil from a spill associated with the Long Wharf (Class I).

Impacts to Vegetated Marshes from a Spill at the Long Wharf

Based on the 100 modeled scenarios of a spill from the Long Wharf, marshes around Brooks Island and Richmond would be at greatest risk from a spill at the Long Wharf. Oil contacted this area in 58 of the spill scenarios. The Emeryville marshes also would be at considerable risk from a spill from the Long Wharf. About 25 of the 100 modeled scenarios resulted in oil contacting this area, and in 18 of the scenarios, the oiling was by greater than trace amounts. The San Pablo and Wildcat Creek marshes north of San Pablo Point also have about a 25 percent chance of being contacted by oil from a spill at the Long Wharf, but only about an 7 percent chance of being contacted by greater than trace amounts of oil. These marshes, therefore, are at moderate risk. Marshes in north and west San Pablo Bay, west Central Bay, and South Bay are at relatively low risk from a spill from the Long Wharf. Ten or less of the 100 modeled spill scenarios resulted in oil contacting these areas.

Impacts to Vegetated Marshes of a Spill from Chevron Tankers

Based on the oil spill modeling done in the Unocal EIR, saltmarsh habitat at highest risk from a spill associated with tankering would be that at Benicia, San Pablo Point, and the northeast end of San Pablo Bay. Saltmarsh most at risk of medium or greater oiling from a tanker spill is around Benicia in Carquinez Strait and around San Pablo Point in southwest San Pablo Bay. These areas would have a 12 to 17.5 percent chance of medium oiling from a tanker spill. Northeast San Pablo Bay marsh would have a 6 to 10 percent chance of medium oiling from a tanker spill. Vegetated marsh at Martinez and south Suisun Bay would have a 2 to 4 percent chance of medium oiling. Other marsh habitat in San Francisco Bay would have less than a 2 percent chance of medium oiling from a tanker spill. Less than 5 percent of the saltmarsh habitat in the San Francisco Bay estuary has greater than a 5 percent probability of being contacted by medium oil from a tanker spill. The overall risk to marshes from a tanker spill is relatively low, although should a spill occur, at least some marsh habitat would be oiled.

The receptor mode analysis in the Unocal EIR focused on the risk to the following important marshes: Corte Madera Creek, San Pablo Creek, Coyote Hills Slough, Montezuma Slough, Napa Slough, the Petaluma River Mouth, Gallinas Creek, the Oakland Marshes, Harbor Bay, and the Sacramento River Mouth. The only target marsh with greater than 1 percent chance of contact with oil from a tanker spill was San Pablo Creek, which had up to a 24 percent chance of contact with oil from a spill from tankers.

Coastal estuaries on the outer coast are at relatively low risk from a tanker spill.

Birds

Sensitivity and Vulnerability to an Oil Spill

Oil spills can affect birds directly through oil contamination and indirectly through degradation of important habitat. The direct effect of oiling on birds is predominantly contamination of feathers, removing insulative qualities and reducing buoyancy (Holmes and Cronshaw 1977; Moskoff 2000). Oiling of feathers leads to elevated metabolic rate and hypothermia (Hartung 1967). Oiled birds may also ingest oil through preening of feathers or feeding on contaminated prey. Effects of ingested oil can range from acute irritation and difficulties in water absorption to general pathologic changes in some organs (e.g., Crocker et al. 1974; Fry 1987; Nero and Associates 1983). Ingestion of oil can also result in changes in yolk structure, and reduction in number of eggs layed and egg hatchability (Hartung 1965; Grau et al. 1977). Oiled birds that are able to return to a nest can contaminate the exterior of eggs, reducing hatchability (e.g., Hartung 1965; Patten and Patten 1977).

Indirect effects result principally from contamination of habitat where feeding occurs. These effects may be significant in shallow waters of bays, mudflats, and estuaries where waterfowl, rails, wading birds, and shorebirds feed. For these birds, loss or reduction in food resources can affect survival during migration and success of nesting efforts.

Marine birds are known to be conspicuous casualties of oil spills (e.g., Hope-Jones et al. 1970; Ford et al. 1991a, b). For example, it has been estimated that between 100,000 and 435,000 birds died within 3 months of the Exxon Valdez spill (Moskoff 2000). Those species suffering greatest mortality from past spills along the outer coast have been alcids, cormorants, loons, grebes, and scoters (Smail et al. 1972; Dobbin et al. 1986; Page and Carter 1986). These groups are more vulnerable because they are found in large numbers on the water. Other birds typically spend less time on the water or will relocate from the area affected by a spill (e.g., gulls and pelicans; Sowls et al. 1980). In the years since the Exxon Valdez spill several species of birds have demonstrated indirect or delayed responses to the spill (NRC 2003). These responses were found in sea ducks and shorebirds, species that forage primarily on intertidal and shallow subtidal invertebrates, as well as several species that forage on small fish found in inshore waters.

Seabirds have regional populations that are centered predominantly off the outer coast. Therefore, the significance of impacts from oil spills must be judged relative to the entire regional population, whether or not spills occur off the outer coast or in the San Francisco Bay estuary. Alcids, especially, are typically the greatest casualty of oil spills due to their abundance on the water and their tendency to dive rather than fly when stressed. The vulnerability of seabirds was emphasized by the Apex Houston spill in the winter of 1986 that killed more than 10,000 seabirds. Substantial mortality of alcids would be significant (Class I) because these species are recovering from impacts from oil spills and entanglement mortality in gill nets.

Large migrant or wintering populations of loons, grebes, and scoters are found along the outer coast and in San Francisco and San Pablo Bays from about October through March. Along the outer coast, loons, grebes, and scoters rest at night on nearshore waters where they can be contacted in large numbers should a spill occur. In the Bays, the migrant or wintering waterfowl also includes large populations of diving or dabbling ducks that spend most time on the water where they can be contacted by oil spills. The San Francisco Bay estuary is used by several hundred thousand waterfowl from late fall through spring as a critical feeding ground. Substantial mortality of wintering waterfowl or loss of essential habitat would likely result from oil spills and would constitute a significant impact (Class I).

In San Francisco-San Pablo Bays, habitat of rails, terns, wading birds, and shorebirds could also be contacted by oil spills (e.g., the Shell Oil Refinery spill near Martinez in April 1988; Palawski and Takekawa 1988). Direct effects on these birds from oil spills are suspected but difficult to assess. Observations of oil-streaked shorebirds are common immediately following oil spills, but carcasses are rarely recovered (Larsen and Richardson 1990). It is likely that shorebirds and wading birds are able to avoid oiling to some extent by retreating from exposed habitat. Even if contacted, they may be able to avoid hypothermia from light oiling because they remain on land and may find some shelter in vegetation. Nevertheless, preening of oiled feathers would lead to ingestion of oil and resultant pathological effects. Another serious concern is secondary impacts from contamination of food resources on beaches and mudflats. Not only could oil ingestion take place during feeding, the presence of oil might substantially reduce the food available to sustain these populations. The San Francisco Bay estuary is used by up to 1 million shorebirds as a critical feeding area in the Pacific Flyway. Substantial mortality of wintering shorebirds or loss of essential habitat would likely result from oil spills and would constitute a significant impact (Class I).

Oiled birds recovered alive sometimes can be successfully cleaned and rehabilitated. Based on a review of the literature, the Unocal EIR estimated the success of mitigation by rehabilitation of oiled birds at 17 percent of the oiled birds for spills in the San Francisco Bay Area and 9 percent on the outer coast.

<u>Impacts to Birds from a Spill at the Long Wharf</u>

To determine the risk to birds from a spill at the Long Wharf, the results of the 100 modeled scenarios of a 1,000-bbl spill at the Long Wharf were analyzed. As discussed in Section 4.1, Operational Safety/Risk of Accident, some segments of the Bay were contacted by oil in most of the scenarios and some were only contacted by a few of the scenarios. Table 4.3-17 lists the bird resources in each segment of the Bay and arranges the segments from those at highest risk of contact by oil from a spill at the Long Wharf to those at lowest risk.

Table 4.3-17
Relative Risks to Birds of a Spill at the Long Wharf
(Based on the number of scenarios of the 100 modeled scenarios of a 1,000 bbl spill at the Long Wharf that contacted each shoreline segment)

<u>Highest Risk</u>

- **East Central Bay** (Point San Pablo to Point Richmond):
    - Seabird Colonies:
    - Western Gull
        - Brothers Rocks - 89 nests;
        - Castro Pt. Area - 4 nests;
        - Richmond-San Rafael Bridge - 9 nests;
        - Red Rock - 192 nests;
        - Long Wharf - 3 nests.
    - Double-crested Cormorant
        - Richmond-San Rafael Bridge - 389 nests.
  - Birds counted in nearshore waters (01 Nov.'97):
    - Point San Pablo Area-
        - Grebes/loons - 30
    - Pt. Molate Area-
        - Grebes/loons/corms - 50

<u>High Risk</u>

- **Brooks Island/Richmond** (Point Richmond to Berkeley Pier):
    - Seabird Colonies:
    - Western Gull
        - Richmond Harbor Entrance - 6 nests;
        - Brooks Island Area - 49 nests;
        - Richmond Inner Harbor - 6 nests;
        - Albany Hill Cove - 1 nest.
    - Black Oystercatcher
        - Brooks Island Area - 1 nest.
    - Caspian Tern
        - Brooks Island Area - 60 nests (est.)
  - Birds counted in nearshore waters (01 Nov.'97):
    - Richmond Inner Harbor -
        - Unidentified Ducks - 600
  - Sensitive habitat:
    - California Clapper Rail (Federal/State Endangered Species)-
        - Area of habitat = 0.378 sq.km
        - Proportion of habitat potentially contacted by oil from any/all scenarios = 3.3 percent

<u>Moderate Risk</u>

- **Berkeley/Emeryville** (Berkeley Pier to Oakland Inner Harbor):
  - Seabird Colonies:
    - Western Gull
        - Berkeley Yacht Harbor Breakwater - 19 nests;
        - Berkeley Pier - 10 nests;
        - Bay Bridge, East - 20 nests;
        - Oakland Outer Harbor - 4 nests;
        - Oakland Middle Harbor - 5 nests;
        - Oakland Inner Harbor - 3 nests.
    - Double-crested Cormorant
        - Bay Bridge, East - 465 nests.
  - Birds counted in nearshore waters (01 Nov.'97):
    - Pt. Isabel Area -
        - Unidentified Ducks - 400
    - Flemming Pt. Area -
        - Unidentified Ducks - 1,000
    - Emeryville Lagoon -
        - Grebes - 30
  - Sensitive habitat:
    - California Clapper Rail (Federal/State Endangered Species)-
        - Area of habitat affected = 0.169 sq.km
            (all in Emeryville Lagoon)
        - Proportion of habitat potentially contacted by oil from any/all scenarios = 1.5 percent

Table 4.3-17 (continued)
Relative Risks to Birds of a Spill at the Long Wharf
(Based on the number of scenarios of the 100 modeled scenarios of a 1,000 bbl spill at the Long Wharf that contacted each shoreline segment)

- **Tiburon/Angel Island** (Peninsula Pt. to Paradise Cay):
    - Seabird Colonies:
    - Western Gull
        - Peninsula Point/Cone Rocks - 3 nests;
        - Angel Island - 3 nests;
    - Bluff Point to Paradise Cay - 2 nests.
- **South-East San Pablo Bay** (Point San Pablo to Lone Tree Pt.):
    - Seabird Colonies:
        - Western Gull
            - Vicinity of Selby - 2 nests;
            - Davis Pt. (Unocal) - 11 nests;
            - Hercules Wharf - 1 nest;
            - Pt. Pinole - 1 nest;
            - E Ship Channel Marker - 3 nests.
    - Birds counted in nearshore waters (5/6 Apr.'95):
        - Lone Tree Pt. to Pt. Pinole-
            - Unidentified Ducks - 500
            - Unidentified Gulls - 50
            - Unidentified Terns - 50
            - Unidentified Waders - 150
    - Density of birds within 5 km of shore (06 Apr.'95):
        - Waterfowl, grebes, and loons = 56/sq.km
        - Gulls and terns = 5/sq.km
    - Sensitive habitat:
        - California Clapper Rail (Federal/State Endangered Species)
            - Area of potential habitat subject to contact by oil = 1.667 sq.km
            - Proportion of habitat potentially contacted by oil from any/all scenarios = 14.5 percent
- **Treasure Island/Yerba Buena Island**:
    - Seabird Colonies:
        - Western Gull
            - Treasure Island - 48 nests;
            - Yerba Buena Island - 31 nests.
        - Brandt's Cormorant
            - Yerba Buena Island - 4 nests.
        - Pelagic Cormorant
            - Yerba Buena Island - 2 nests.
    - Birds counted on nearshore waters (01 Nov.'97):
        - Grebes - 6
        - Unidentified Cormorants - 2

<u>Low Risk</u>

- **Carquinez Strait**:
    - Seabird Colonies:
        - Western Gull
            - Mare Island Breakwater - 10 nests;
            - Jones Pt. to Benicia Pt. - 5 nests.
    - Birds counted on nearshore waters (06 Apr.'95):
        - Mare Island Strait Entrance -
            - Unidentified Ducks - 85
        - Southhampton Bay-
            - Unidentified Scaup - 45
            - Unidentified Gulls - 110
            - Unidentified Cormorants - 20
            - Grebes/loons - 3
        - Benicia Pt. -
            - Unidentified Gulls - 45
            - Unidentified Cormorants - 2
            - Unidentified Waders - 50

Table 4.3-17 (continued)
Relative Risks to Birds of a Spill at the Long Wharf
(Based on the number of scenarios of the 100 modeled scenarios of a 1,000 bbl spill at the Long Wharf that contacted each shoreline segment)

Martinez Reg. Shoreline -
Unidentified Scaup - 35
Unidentified Gulls - 50

North San Pablo Bay (Petaluma River to Mare Island Breakwater):
Seabird Colonies:
Double-crested Cormorant
Russ Island (diked wetlands) - 153 nests;
Knight Island (diked wetlands) - 65 nests;
N San Pablo Bay Radar Target - 20 nests;
NE San Pablo Bay Beacon - 4 nests.
Forster's Tern
Island No. 2 (diked wetlands) - 25 nests;
Knight Island (diked wetlands) - 135 nests.
Caspian Tern
Knight Island - 38 nests.
Western Gull
Knight Island - 4 nests;
NE San Pablo Bay Beacon - 1 nest.

Birds counted in nearshore waters (5-6 Apr.'95):
Sonoma Creek to Mare Island Breakwater-
Unidentified Ducks - 4,000
Unidentified Gulls - 375
Unidentified Waders - 2,400

Density of birds within 5 km of shore:
Waterfowl, grebes, and loons = 358/sq.km
(06 April '97);
Gulls and terns = 13/sq.km

Sensitive habitat:
California Clapper Rail (Federal/State Endangered Species)-
Area of habitat affected = 2.829 sq.km
Proportion of habitat potentially contacted by oil from any/all scenarios = 24.6 percent

West Central Bay (Paradise Cay to Pt. San Pedro):
Seabird Colonies
Western Gull
Pt. San Quentin - 3 nests;
Marin Islands - 18 nests;
Black Oystercatcher
Marin Islands - 1 nest.

Birds counted on nearshore waters (01 Nov.'97):
Bothin Marsh -
Unidentified Ducks - 110 (at least 30 Bufflehead ducks)
S of Pt. San Quentin -
Unidentified Scoters - 125
Unidentified Dabblers - 25
Western Grebes - 25
N of Pt. San Quentin -
Unidentified Ducks - 50
Unidentified Scoters - 200
Bufflehead Ducks - 25
Near Pt. San Pedro -
Unidentified Ducks - 25
Western Grebes - 25

Density of birds within 5 km from shore:
Waterfowl, grebes, and loons - 678/sq.km
(27 May '97)
Gulls and terns - 43/sq.km
(06 Apr.'95)
Sensitive habitat:
California Clapper Rail (Federal/State Endangered Species)-
Area of habitat affected = 1.219 sq.km
(most habitat in vicinity of Corte Madera Cr. and San Rafael Cr.)
Proportion of habitat potentially contacted by oil from any/all scenarios = 10.6 percent

Table 4.3-17 (continued)
Relative Risks to Birds of a Spill at the Long Wharf
(Based on the number of scenarios of the 100 modeled scenarios of a 1,000 bbl spill at the Long Wharf that contacted each shoreline segment)

San Francisco Peninsula (San Mateo Bridge to Fort Point):

- Seabird Colonies:
  - Western Gull
    - San Mateo Br./PG&E Towers - 3 nests;
    - Oyster Pt. - 1 nest;
    - Hunter's Pt./South Basin Area - 26 nests;
    - Lash Lighter Basin - 20 nests;
    - Potrero Pt. - 3 nests;
    - S F Piers, South -116 nests;
    - Bay Bridge, West - 24 nests;
    - S F Piers, North - 31 nests;
    - Pier 45 - 33 nests;
    - Alcatraz Island - 450 nests.
  - Brandt's Cormorant
    - Alcatraz Island - 62 nests.
  - Pelagic Cormorant
    - Alcatraz Island - 12 nests.
  - Double-crested Cormorant
    - San Mateo Br.-PG&E Towers - 76 nests.
  - Pigeon Guillemot
    - Alcatraz Island -14 nests.
  - Forster's Tern
    - Oyster Pt. - 5 nests.

- Birds counted in nearshore waters (01 Nov.'97):
  - South San Francisco -
    - Unidentified Ducks - 75
    - Western Grebes - 25
  - South of Candlestick Park -
    - Unidentified Ducks - 300
    - Unidentified Gulls - 1,200
    - Unidentified Grebes - 200
  - South Basin Area-
    - Grebes/loons - 20
    - Unidentified Scoters - 10
  - Golden Gate Nat. Rec. Area -
    - Unidentified Ducks - 50

Alameda (Entrance to Oakland Inner Harbor to San Mateo Br.):

- Seabird Colonies:
  - Western Gull
    - Alameda Naval Air Station - 251 nests;
  - Least Tern
    - Alameda Naval Air Station - 78 nests;
    - Oakland Int. Airport - 9 nests;
  - Caspian Tern
    - Alameda Naval Air Station - 594 nests.

- Birds counted on nearshore waters (01 Nov.'97):
  - Alameda Naval Air Station -
    - Grebes - 2
  - Ballena Bay-
    - Unidentified Ducks - 400
    - Unidentified Scoters - 500
    - Bufflehead Ducks - 25
  - San Leandro Channel -
    - Unidentified Shorebirds - 400
    - Unidentified Ducks - 100
    - Unidentified Scoters - 500
    - Grebes/loons - 700
  - Bay Farm and Oakland Int. Airport -
    - Unidentified Scoters - 650
    - Western Grebes - 12
  - S Shore of Oakland International Airport-
    - Unidentified Scoters - 15,800
  - Oyster Bay -
    - Unidentified Scoters - 1,500
  - San Leandro Marina -
    - Surf Scoters - 1,425

Table 4.3-17 (continued)
Relative Risks to Birds of a Spill at the Long Wharf
(Based on the number of scenarios of the 100 modeled scenarios of a 1,000 bbl spill at the Long Wharf that contacted each shoreline segment)

- Robert's Landing Area -
  - Unidentified Ducks - 1,500
  - Unidentified Dabblers - 100
  - Unidentified Waders - 1,600
- Johnson Landing -
  - Unidentified Scoters - 800
  - Unidentified Waders - 2,500
- San Mateo Bridge, East-
  - Unidentified Scoters - 70
  - Western Grebes - 50
  - Unidentified Waders - 800

Sensitive habitat:
- California Clapper Rail (Federal/State Endangered Species)-
  - Area of habitat affected = 0.411 sq.km
    - (all bordering San Leandro Bay)
  - Proportion of habitat potentially contacted by oil from any/all scenarios = 3.6 percent

Marin (Golden Gate Bridge to Sausalito Pt.):

Seabird Colonies:
- Western Gull
  - Yellow Bluff - 1 nest.

Birds counted on nearshore waters (01 Nov.'97):
- Horseshoe Bay/Pt. Cavallo -
  - Western Grebes- 10

Sensitive habitat: None

Richardson Bay:

Seabird Colonies:
- Western Gull
  - Sausalito Pt. - 2 nests.

Birds counted on nearshore waters (01 Nov.'97):
- Richardson Bay -
  - Western Grebes - 1,140

Sensitive habitat:
- California Clapper Rail (Federal/State Endangered Species)-
  - Area of habitat affected = 0.048 sq.km
    - (all NE of Strawberry Spit)
  - Proportion of habitat potentially contacted by oil from any/all scenarios = 0.4 percent

West San Pablo Bay (Pt. San Pedro to Petaluma River):

Seabird Colonies:
- Western Gull
  - Sisters Rocks and Pt. San Pedro - 18 nests;
  - Rat Rock - 1 nest;
  - Duck Blinds - 4 nests (16 birds);
  - Petaluma River Boat Channel - 7 nests;
  - Mud N of Petaluma River - 1 nests.

Birds counted in nearshore waters (06 Apr.'95):
- No Data

Density of birds within 5 km of shore (06 Apr.'95):
- Waterfowl, grebes, and loons - 130 birds/sq.km
- Gulls and terns - 3 birds/sq.km

Sensitive habitat:
- California Clapper Rail (Federal/State Endangered Species)-
  - Area of habitat affected = 4.776 sq.km
  - Proportion of habitat potentially contacted by oil from any/all scenarios = 41.5 percent

Sensitive species:
- California Brown Pelican (Federal/State Endangered)-

East Central Bay is at highest risk of contact by oil from a spill at the Long Wharf. The most sensitive species in this segment is the double-crested cormorant, which has a large colony on the Richmond-San Rafael Bridge. Cormorants have wettable plumage that must be dried in the air every few hours to provide adequate insulation and buoyancy. Consequently, they frequently return to coastal roosts rather than rest on the water. To some extent they are less vulnerable to oil spills than species that remain on the water. Not only do they spend some time on land, they also may relocate to other roosting sites if disturbed.

Cormorants are most vulnerable during the spring-summer breeding season when they have strong ties to nesting colonies. Cormorants do not have the ability to store energy as fat and consequently must forage each day regardless of the presence of oil nearby. Therefore, if a spill from the Long Wharf occurred during the nesting season, the cormorant colony on the Richmond-San Rafael Bridge would be at very great risk. Although western gulls nest on rocks and structures in this segment, western gulls are not particularly vulnerable to an oil spill because they forage widely in the area, including on land, and do not spend a large portion of their time on the water. A relatively low number of waterfowl occurs in the east Central Bay segment.

The segment with the second highest risk of being contacted by a spill at the Long Wharf is the Brooks Island/Richmond segment. About 60 Caspian terns nest on a sand spit on Brooks Island. This colony would be at substantial risk from a spill at the Long Wharf. However, Caspian terns have a large and widespread nesting population in the San Francisco Bay Area (approximately 1,409 nesting pairs), and impacts to this relatively small colony would not have a significant impact to the local Caspian tern population. Similarly, the 62 pairs of western gulls that nest in this segment would be at risk from a spill at the Long Wharf, but impacts to this widespread species would not be significant. A spill at the Long Wharf could contact the marsh habitat found in this segment and affect the endangered California clapper rail. Marsh habitat in the Brooks Island/Richmond segment comprises approximately 3.3 percent of the clapper rail habitat in San Francisco Bay. Waterfowl in this segment would be at high risk from a Long Wharf spill, but the number of waterfowl in the Brooks Island/Richmond area typically is relatively low. In addition, many California brown pelicans use Brooks Island as a roost during October through May. While somewhat protected from oil while on land, they are vulnerable to oiling as they forage in open water of Central Bay.

Based on the 100 modeled spill scenarios, Bay segments at moderate risk from a spill at the Long Wharf include the Berkeley/Emeryville segment, the Tiburon/Angel Island area, southeast San Pablo Bay, and Treasure Island/Yerba Buena Island. Bird resources in those segments that are of particular concern include the double-crested cormorant colony on the Bay Bridge in the Berkeley/Emeryville segment and clapper rail habitat in the Berkely/Emeryville segment and southeast San Pablo Bay. The double-crested cormorant colony on the Bay Bridge is the largest in the San Francisco estuary. If a spill occurred during the nesting season, cormorants might be oiled as they tried to forage near their colony.

A substantial amount of vegetated marsh that supports California clapper rails occurs in southeast San Pablo Bay. The southeast San Pablo Bay marshes represent about 14.5 percent of the clapper rail habitat in San Francisco Bay. The clapper rail habitat in the Berkeley/Emeryville segment represents only 1.5 percent of the clapper rail habitat in San Francisco Bay. None of the segments at moderate risk from a Long Wharf spill is characterized by large numbers of waterfowl.

Based on the 100 modeled spill scenarios, the rest of San Francisco Bay is at relatively low risk from a spill at the Long Wharf. Therefore, the high numbers of waterfowl found seasonally in north and west San Pablo Bay and in South Bay are unlikely to be contacted by oil from a Long Wharf spill. Most of the marshes that support California clapper rails are unlikely to be contacted by a spill at the Long Wharf. For example, 41.5 percent of the California clapper rail habitat is in marshes in west San Pablo Bay. The west San Pablo Bay shoreline segment was only contacted by oil in 8 of the 100 modeled scenarios. The least tern colony at Alameda also is at low risk from a spill at the Long Wharf. Oil contacted the Alameda segment in 7 of the 100 spill scenarios. The black-crowned night heron colony on the Marin Islands in west Central Bay has about an 8 percent chance of being contacted by oil from a spill at the Long Wharf.

Five representative scenarios were selected to analyze the range of impacts that could be expected from a spill at the Long Wharf. Table 4.3-18 predicts the impacts to waterfowl and shorebirds from each of the five selected scenarios. The mortality is based on estimated number of birds in each segment contacted by oil and an assumption that 17 percent of the birds contacted by oil could be rehabilitated. The South-East San Pablo Bay scenario (#93), in which oil was carried north into southeast San Pablo Bay, had the greatest potential to affect waterfowl. The South-East San Pablo Bay scenario (#93) was predicted to result in a loss of up to 1.6 percent of the wintering waterfowl population of the Bay. None of the modeled spills reached the area of high winter waterfowl density in north San Pablo Bay. Therefore, none of the scenarios was predicted to result in a loss of a large proportion of the wintering waterfowl population of the Bay. Impacts to waterfowl of the five representative Long Wharf spills were adverse, but less than significant (Class III). Similarly, none of the five representative scenarios of a spill at the Long Wharf was predicted to result in a loss of a substantial portion of the shorebirds that use the tidal waters of San Francisco Bay. The West San Pablo Bay scenario (#91), in which oil spread into the expansive mudflats of west San Pablo Bay, had the potential to affect the greatest number of shorebirds. Approximately 4.4 percent of the wintering shorebird population in the tidal areas of San Francisco Bay was predicted to be lost from contact with oil in this scenario. The relatively low impacts to shorebirds predicted from a spill at the Long Wharf are a result of the fact that all of the five representative scenarios resulted in oil contacting less than 10 percent of the intertidal mudflat habitat in San Francisco Bay. Impacts to shorebirds in these five representative spill scenarios were adverse, but less than significant (Class III).

Table 4.3-18
Waterfowl and Shorebird Mortality Predicted from Five Modeled Oil Spills from the Long Wharf

	Berkeley/ Emeryville #33		West Central Bay #68		Brooks Island/ Richmond #73		West San Pablo Bay #91		South-East San Pablo Bay #93	
	Mortality	Percent	Mortality	Percent	Mortality	Percent	Mortality	Percent	Mortality	Percent
Waterfowl*	84-335	0.2	273-1,091	0.6	82-726	0.4	164-657	0.3	792-3,170	1.6
Shorebirds†	9,063	1.4	21,557	3.3	20,875	3.1	28,925	4.4	20,054	3

* Predicts use based on an estimated total population in San Francisco Bay of 193,000 birds from October through March.
† Based on an estimate of 232,326 in tidal areas.

In all of the five scenarios, oil spread to the waters beneath the Richmond-San Rafael Bridge. Therefore, if a spill at the Long Wharf occurred during the nesting season, the large double-crested cormorant colony on this bridge would be at high risk. In two of the spill scenarios, the Berkeley/Emeryville scenario (#33) (see Figure 4.3-10) and the Brooks Island/Richmond scenario (#73), oil also was carried to the waters below the Bay Bridge, where the largest double-crested cormorant colony in San Francisco Bay nests. Therefore, if a spill at the Long Wharf occurred during the breeding season and oil was carried southeast, almost all the nesting double-crested cormorants in San Francisco Bay would be at risk. Although some individuals might fly to unoiled areas to feed, it is highly likely that many birds would attempt to feed in oily waters and come in contact with the oil.

The Berkeley Emeryville (#33) and Brooks Island/Richmond (#73) scenarios both contacted Brooks Island where a Caspian tern colony of about 60 pair nests on a sand spit. Therefore if a spill at the Long Wharf occurred during the breeding season, impacts to this colony would occur. However the Brooks Island colony represents less than 10 percent of the breeding Caspian terns in the San Francisco estuary and impacts to the local breeding population as a whole would not be significant. In the other three scenarios, oil did not contact Brooks Island and little or no impact to Caspian terns would occur. Impacts to Caspian terns in these five representative spill scenarios were adverse, but less than significant (Class III).

In all of the five scenarios, oil contacted Red Rock and the Brothers, where large numbers of western gulls nest. If a spill occurred during the breeding season, some impact to this species would occur but because gulls are widespread in the Bay and because they forage frequently on land, impacts probably would not be significant .

In all of the five scenarios, some vegetated marsh habitat was contacted by oil. The West San Pablo Bay scenario (#91) affected the greatest amount of marsh. In this scenario, 0.8 acre of marsh, representing 1.3 percent of the marsh habitat in the Bay, was contacted by the spill. Therefore, while impacts to the California clapper rail from a spill at the Long Wharf are possible, few individuals are likely to be contacted by oil.

Figure 4.3-10 – Berkeley/Emeryville Oil Spread Scenario – Impacts to Sensitive Bird Species

In three of the five scenarios (#68, #73, #91), oil contacted the Marin Islands. Therefore, the large black-crowned night heron colony that nests there could be affected by a spill at the Long Wharf if the spill occurred during the breeding season. However, because black-crowned night herons nest throughout San Francisco Bay, including areas out of the reach of oil spills, impacts would not be significant at the population level.

None of the five scenarios resulted in oil coming near the colony of the endangered California least terns at Alameda. Although the impacts to many types of marine birds from the modeled scenario of a spill at the Long Wharf resulted in adverse, but less than significant (Class III) impacts. It should be recognized that a large spill under the wrong weather conditions could impact sensitive bird habitats that were not affected by the modeled scenarios.

Impacts to Birds of a Spill from Chevron Tankers

Because of the widespread distribution of waterfowl, any oil spill from October through about April would probably contact some portion of the population. Based on the analysis in the Unocal EIR, greatest probabilities of contact from tanker spills within the Bay occur near the ship channel through San Pablo Bay, and northern and central San Francisco Bay. Areas of San Pablo Bay where waterfowl are found at highest densities are subject to a 10 to 40 percent chance of contact; there is a 6 to 8 percent chance of moderate oiling and a 1 to 2 percent chance of heavy oiling. Most waterfowl habitat in south San Francisco Bay is subject to a negligible chance of contact from tanker spills. The overall risk to waterfowl from a spill originating from Chevron tankers would, however, be relatively high because of the vulnerability of waterfowl in San Pablo Bay.

Based on the analysis in the Unocal EIR, intertidal mudflats critical to wintering shorebirds are at substantial risk of contact from a tanker spill. The likelihood of medium to heavy oiling is generally less than 4 percent, but may reach 6 to 12 percent along Contra Costa County from Point Richmond to Point San Pablo. Almost all intertidal mudflats in south San Francisco Bay are subject to a negligible chance of contact from oil spills from Chevron tankers (less than a 1 percent chance). Therefore, although a tanker spill would be unlikely to contact much of the tidal habitat for shorebirds in San Francisco Bay, some mudflat areas are at high risk from a tanker spill.

Table 4.3-19 lists important seabird colonies in San Francisco Bay and the relative risk from spills along the tanker route within the Bay. Spills along the tanker route have a substantial chance of contacting all colonies, except those in south San Francisco Bay. Most of the important seabird colonies in San Francisco Bay have a greater than 10 percent chance of being contacted by a tanker spill and are considered to be at high risk.

Table 4.3-19
Level of Risk of Contact of Crude Oil Spills to Major Seabird Colonies in San Francisco, San Pablo, and Suisun Bays, from Oil Spills Released by Chevron Tankers

Location	Species	Relative Risk Chevron Tankers
N. San Pablo Bay Radar Target	DOCO	H
NE San Pablo Bay Beacon	DOCO	H
Davis Point	WEGU	H
Wheeler Island	DOCO	M
Sisters Rocks	WEGU	H
Brothers Rocks	WEGU	H
Richmond/San Rafael Bridge	DOCO	H
Red Rock	WEGU	H
Brooks Island	WEGU/CATE	H
Alcatraz Island	WEGU	H
Pier 45	WEGU	H
SF Piers, North	WEGU	H
SF Piers, South	WEGU	M
Treasure Island	WEGU	H
Yerba Buena Island	BRCO/PECO/WEGU	H
SR/Oakland Bay Bridge, East	DOCO	H
Hunters Point	WEGU	M
Leslie/Baumberg Salt Ponds	FOTE/CATE	L
Alviso Plant Salt Ponds	CAGU	L
Charleston Slough	FOTE	L
Bair Island Ponds	FOTE	L
San Mateo Bridge/PG&E Towers	DOCO	L

SPECIES KEY

DOCO - double crested cormorant	**CAGU - California gull**	**L = Low Risk (<1 percent chance)**
BRCO - Brandt's cormorant	**FOTE - Forster's tern**	**M = Moderate risk (1 to 10 percent chance**
PECO - Pelagic cormorant	**CATE - Caspian tern**	**H = High risk (>10 percent chance)**
WEGU - western gull		

Four tanker spill scenarios analyzed in the Unocal EIR were used to estimate the range of impacts from a spill from tankers servicing the Long Wharf. Two of these spills (Scenarios 9 and 10) were of a 100,000-bbl spill from a tanker near Alcatraz. Scenario 9 contacted intertidal mudflats in Central Bay and San Pablo Bay, while Scenario 10 contacted intertidal mudflats in Central and South Bays. Because the greatest amount of intertidal mudflat habitat occurs along the shores of South Bay and San Pablo Bay, both spills had the potential to affect a substantial number of shorebirds, but neither spill would affect most of the wintering shorebird population in the Bay. Based on data on the numbers and distribution of shorebirds in different parts of the Bay, the Unocal EIR estimated that Scenario 9 would result in mortality to 14.5 percent of the shorebirds in the Bay and Scenario 10 would result in mortality of 12 percent of the wintering shorebird population. Scenario 9, which was of a 100,000-bbl tanker spill in March, was predicted to spread oil to areas that contained a total of 53.9 percent of the wintering waterfowl in San Francisco Bay and would result in mortality to between 2,100 and 8,500 individuals. Scenario 10 was a spill in September when most waterfowl are still on their wintering grounds. The number of waterfowl affected by a large spill at this time would be low. Scenarios 9 and 10 both contacted most of the major seabird colonies in San Francisco Bay. In summary, Scenario 9 would have a significant impact on wintering waterfowl and seabird colonies and probably also on shorebirds (Class I). Scenario 10 also would have a significant, adverse impact on seabird colonies and probably shorebirds (Class I), but because of the time of year, not on waterfowl (Class III).

The other two tanker spill scenarios analyzed in the Unocal EIR were of a 1,000-bbl spill from Anchorage 9 (Scenarios 11 and 12). Both spills carried oil into intertidal mudflat habitat in the South Bay. Scenario 11 was predicted to result in mortality to 8.5 percent of the shorebird population in the Bay and Scenario 12 was predicted to result in mortality to 13 percent of the shorebird population. Therefore, both of these modeled tanker spills, like those modeled in Scenarios 9 and 10, could potentially have a significant, adverse impact on shorebirds (Class I). Scenario 12, which was a spill in August, would not affect wintering waterfowl. Scenario 11, a spill in November, was predicted to contact parts of the Bay in which about 4.1 percent of the wintering waterfowl population occurs. The estimated mortality to waterfowl in this spill scenario was 200 to 600 birds, which would be an adverse but less than significant impact (Class III). Spills 11 and 12 did not contact any of the major seabird colonies in the Bay.

Seabirds off the outer coast of California have colonies at over 200 locations. Colonies are not usually contacted directly by oil due to their elevation above the water. However, the density of birds on the water is greatest near the colonies and it is there that impacts are likely to be greatest. Therefore, colony location is used only as an indicator of important habitat. Oil spill modeling in the Unocal EIR showed that the probability of contact with one or more colonies along the outer coast, should a spill occur, is near certainty for cormorants and western gulls, and high for alcids, because colonies exist at a great many locations along the coast. For seabirds such as storm-petrels with colonies at only a few sites, the probability of contact from a tanker spill is less than 30 percent.

Based on oil spill modeling done in the Unocal EIR and the GTC Marine Terminal EIS/EIR, major outer coast seabird colonies that have a relatively high probability of being contacted from a tanker spill include the Farallon Islands offshore San Francisco and San Miguel Island in the Santa Barbara Channel. Two scenarios of a tanker spill along the outer coast were analyzed in the Unocal EIR. Outer coast Scenario 1, a spill near the Farallon Islands in March, could result in substantial mortality of alcids, up to about 5.6 percent of total numbers on the water from Monterey Bay to Oregon. Considering that it occurs at the start of the breeding season, Scenario 1 could produce enormous impacts on colonies at the Farallon Islands, Point Reyes, Point Resistance, and Double Point Rocks. Alcids in these colonies include common murres, pigeon guillemots, Cassin's auklets, rhinoceros auklets, and tufted puffins, with a combined population of about 135,000 (Carter et at. 1990). Scenario 1 could result in loss of 28 percent of local alcid populations; recovery would require several years, during which time the population would be especially vulnerable to additional impacts. The largest colony in the world of Ashy storm-petrels occur on southeast Farallon Island; however, they were not contacted in great numbers by Scenario 1 because they forage farther from shore. An oil spill the size of Scenario 1 (contacting about 2,500 square km) that occurs farther from shore could contact over 400 Ashy storm-petrels, or about 8 percent of the world population. Cormorants in the Gulf of the Farallones could suffer loss of about 5.8 percent of the 22,000 birds nesting in the area. The March scenario spill also produced substantial mortality to loons, grebes, and scoters, and tubenose-birds (during this season, principally storm-petrels). Outer coast Scenario 1 would result in a significant (Class I) impact on seabirds. Scenario 2, a spill from a tanker southwest of Punta Gorda in October, resulted in death of up to 10,000 birds, but these numbers might be regained without substantial threat to the health of populations. Outer coast Scenario 2 would not have substantial impacts on seabirds.

Marine Mammals

<u>Sensitivity and Vulnerability to an Oil Spill</u>

Direct effects of oiling on pinnipeds and sea otters include both surface contamination of fur and possible ingestion of oil while grooming or during suckling of pups. Harbor seals, elephant seals, and sea lions rely predominantly on subcutaneous fat and a high metabolic rate to keep warm. In contrast, fur seals and sea otters depend on the integrity of an air layer trapped in clean fur to provide insulation and buoyancy. Harbor seal pups may be born with a lanugo coat of dense wooly fur to keep them warm until they have stored sufficient subcutaneous fat. These fur-bearing pinnipeds are at particular risk from an oil spill because oiling can reduce the heat-bearing properties of the fur and result in hypothermia and death.

Sea otters, fur seals, and very young harbor seal pups are at extreme risk of mortality from oil spills. The California population of sea otters (threatened) are restricted to nearshore waters where they can be trapped by oil. A compounding factor is the longer residence-time of oil in kelp beds relative to high-energy environments of most open beaches and rocky shore. There is no evidence that sea otters are able to successfully avoid oiling if a spill reaches nearshore waters, and both adults and younger animals are equally susceptible to death from oiling. Fur seals, while sensitive to oiling, are typically found over the continental slope and waters farther offshore. They may be able to avoid spreading oil to some degree, simply because they are free to relocate in pelagic waters as an oil spill advances. Harbor seal pups with a lanugo coat are susceptible to impacts from oil spills in the first week of life. After molt of the natal fur, and when sufficient fat has been acquired, oil contamination is not likely to have adverse effects. Elephant seal pups also depend to some extent on the natal fur. However, due to their larger heat-producing mass, oiling of the natal pelage is not likely to result in death.

Cetaceans have smooth skin to which oil does not readily adhere. Direct effects of oil spills are limited in large part to inhalation of volatile components and ingestion during feeding by baleen whales. Baleen whales feed opportunistically, but regularly visit specific feeding grounds where euphausiid crustaceans and other invertebrates or small fish form dense shoals. Along the outer coast, the Gulf of the Farallones and Monterey Bay are important feeding grounds in the summer and fall for humpback, blue, and fin whales. Gray whales, although abundant in winter and spring, feed infrequently and only opportunistically during migration.

The extent to which large whales will avoid oil spills is still unclear. Migrating gray whales have been noted making some attempt to avoid natural oil seeps, but the behavior is inconsistent (Kent et al. 1983). Humpback whales have been observed feeding in an area off Cape Cod where thin oil sheens were present from the Regal Sword spill (Goodale et al. 1979).

Toothed whales, which use echo-location to orient and find prey, may be able to avoid oil slicks. In studies with captive animals, bottlenose dolphins were found to reliably detect oil in a slick 1 millimeter thick and avoid contact (in our analysis, classified as heavy oil; Geraci et al. 1983; Smith et al. 1983).

Marine mammals found in San Francisco and San Pablo Bays include harbor seals, California sea lions, and harbor porpoises (gray whales and humpback whales occasionally wander into the Bays but are not part of the typical fauna). Harbor seals in the Bays may be subject to oil spill impacts because they breed and give birth to pups in the area. Harbor seals (particularly pups) may be at risk from oiling both on land and in the water. California sea lions in the Bays are migrant adult males and juveniles that are present in relatively small numbers in the fall and winter. Because they are not known to be especially sensitive to oil impacts, and have a very large and expanding population off the outer coast, any impacts of oil spills in the Bays would be adverse but less than significant (Class III). Harbor porpoises are rare in the Bays, relative to numbers in the Gulf of the Farallones, are highly mobile and may avoid oil slicks, and are not known to be especially sensitive to oil contact. Therefore, impacts of oil spills are likely to be adverse, but less than significant (Class III). Gray whales and humpback whales occasionally wander into the Bays but do not typically occur there; because of their rarity in the area, impacts on these species would be adverse, but less than significant (Class III).

Pacific harbor seals occur both along the outer coast and in the San Francisco and San Pablo Bays, and constitute a single intermixing regional population. Therefore, the magnitude of impacts to harbor seals in the Bays must be evaluated in terms of the entire population that provides recruitment into the regional area.

Oil on land and in the nearshore waters where harbor seals forage would produce greatest damage during the spring pupping season. Although adult harbor seals can die in oil spills, this would be relatively rare and have a minor effect on the population. From data in Mansfield (1970), heavy oiling of a haulout site might kill up to 5 percent of adult animals present. A more serious threat is oiling of newborn pups whose dense fur (lanugo) protects them from cold. Death could result from hypothermia, ingestion of oil, or starvation if separated from the mother.

The pinniped fauna of the outer coast includes, in addition to harbor seals, northern elephant seals, California sea lions, Steller sea lions (threatened), and northern fur seals. Guadalupe fur seals (threatened) may also be present offshore in very small numbers. Because of their rarity in the area, impacts on Guadalupe fur seals are considered adverse, but less than significant (Class III). Impacts on the threatened Steller sea lion population are analyzed below in the Rare/Threatened/Endangered species section.

Should a very large spill occur from a Chevron tanker, substantial mortality of northern fur seals could result due to the species' sensitivity to oiling - a significant impact (Class I). California sea lions and northern elephant seals have large and growing regional populations. Mortality of California sea lions and northern elephant seals may be as great as 5 percent of numbers heavily oiled (calculated from data in Mansfield 1970), but is probably less than 1 percent for most spills. This is because these pinnipeds predominantly depend on subcutaneous fat and a high metabolic rate for protection from cold. A few observations following oil spills indicate that mortality of oiled phocid seals and sea lions cannot be reliably discriminated from mortality due to natural causes (summarized in Geraci and St. Aubin 1985). Habitat would not be permanently lost by a reasonable worst-case oil spill and effects on populations probably would not be measurable. Therefore, impacts of a spill from Chevron tankers on these species would be adverse, but less than significant (Class III).

Sea otters (federal threatened) have a restricted distribution and are very vulnerable to oil because of their fur. Impacts of a spill from a Chevron tanker on this species could be significant (Class I).

Gray whales have not been observed to suffer from fatalities in oil spills. Migrating gray whales have been observed changing direction to avoid natural oil seeps in the Santa Barbara Channel; however, the behavior was not consistently noted (Kent et al. 1983). Given the lack of evidence of mortality in previous oil spills, and the probability that only a small portion of migrating whales might be contacted, impacts from Chevron tanker spills would be adverse, but less than significant (Class III).

Dolphins and porpoises are not believed to be particularly vulnerable to oil spill impacts (Geraci and St. Aubin 1985). Although they are able to actively avoid oil slicks in captivity, their ability to do so in the open ocean has not been demonstrated. Few small cetaceans are known to have been killed in past oil spills. This is due in large part to their mobility and probable ability to avoid patches of thick oil. On this basis, impacts of oil spills from Chevron tankers would be adverse, but less than significant (Class III).

Impacts to Marine Mammals from a Spill at the Long Wharf

The harbor seal haulout site at greatest risk from a spill at the Long Wharf is Castro Rocks. Based on the 100 modeled scenarios of a spill at the Long Wharf, these rocks have about an 87 percent chance of being contacted by a spill at the Long Wharf. Harbor seal haulout sites at Yerba Buena Island and Angel Island are at moderate risk from a spill at the Long Wharf. These sites were contacted by oil in 20 and 22 of the 100 scenarios. All other harbor seal haulout sites in the Bay are at relatively low risk from a spill at the Long Wharf.

To determine the range of effects a spill at the Long Wharf could have on various resources, five representative oil spill scenarios were analyzed in detail. In all five scenarios, oil contacted the important harbor seal haulout site at Castro Rocks. Castro Rocks was the only haulout site contacted in the West San Pablo Bay scenario (#91) and the South-East San Pablo Bay scenario (#93). The Berkeley/Emeryville scenario (#33) contacted two harbor seal haulout sites, Castro Rocks and Angel Island, while the West Central Bay scenario (#68) contacted sites at Castro Rocks, Angel Island, and Corte Madera. The Brooks Island/Richmond scenario (#73) contacted the greatest number of harbor seal haulout sites. In this scenario, oil contacted four sites: Castro Rocks, Angel Island, Yerba Buena Island, and Corte Madera. None of the five scenarios resulted in oil contacting harbor seal haulout sites in South Bay, Richardson Bay, or at Tubbs Island in north San Pablo Bay.

Impacts to Marine Mammals of a Spill from Chevron Tankers

The analysis in the Unocal EIR determined that the harbor seal haulout sites at Angel Island and Yerba Buena Island were at high risk (greater than 10 percent chance of contact by oil) from a tanker spill and sites at Tubbs Island, Castro Rocks, and California Point were at moderate risk (1 to 10 percent chance of being contacted by oil). Therefore, within San Francisco Bay, harbor seals would be at substantial risk only from tanker transport past their haulout sites at Tubbs Island, Castro Rocks, the vicinity of California Point, Angel Island, and Yerba Buena Island. In combination, these sites provide habitat for resting and breeding for about 38 percent of the harbor seal population in the San Francisco Bay Area. All other haulout sites are at low risk should a tanker within the Bay spill oil.

Two of the oil spill scenarios analyzed in the Unocal EIR represent reasonable worst-case scenarios for a tanker spill within the Bay. Scenario 9 modeled the fate of a very large spill from the tanker lane near Alcatraz Island. The oil from the 100,000-bbl release was carried north by March winds and a flood tide into San Pablo Bay producing light oiling, and south as far as Hunters Point and Alameda producing medium oiling. Most of the oil remained in north and central San Francisco Bay producing medium to heavy oiling of haulout sites in Richardson Bay, Angel Island, Yerba Buena Island, and Castro Rocks. The timing of the modeled spill was a worst case for harbor seals, in that March is the beginning of the pupping season and populations on land begin to increase. This spill could oil a substantial number of harbor seals, including pups; cleanup activities might cause additional impacts by displacing animals from important habitat. Impacts from such a spill could potentially affect about 35 percent of the local population (i.e., harbor seals in San Francisco Bay); based on impacts of actual oil spills elsewhere, mortality might be as great as 50 to 100 animals, but would probably be less. If mortality was this great, a substantial portion of harbor seal numbers in San Francisco Bay would be lost (approximately 10 to 20 percent), but less than 1 percent of the estimated California population. A more serious consequence of such spills would be further degradation of the environment that provides a nursery for pups. Studies elsewhere suggest that protected waters of bays and estuaries are the preferred pupping grounds of harbor seals (Allen et al. 1989; Bonnell et al. 1991).

Scenario 10 was also a very large spill (100,000 bbls) near Alcatraz Island during the flood tide, but was acted upon by September winds. Oil heavily contaminated waters of the central San Francisco Bay from the Richmond-San Rafael Bridge in the north to about Hunters Point and Oakland International Airport in the south. Some oil entered Richardson Bay but did not contaminate the shore. Only haulout sites on Angel Island and Yerba Buena Island were contacted with oil. Such a spill in September would affect a sizable population of molting animals.

Along the outer coast, harbor seals haul out at a great many locations. Therefore, there is a very high probability that one or more sites would be contacted should a tanker spill occur. As was true of other biological resources, the greatest relative risk is to harbor seal habitat in the Gulf of the Farallones and southward toward Monterey Bay, as well as on the northern Channel Islands.

Other species of pinnipeds can contact oil spills in open waters where they feed or on land where they rest and breed. Sea lions generally forage each day within 20 to 30 km of their haulout sites. The likelihood of some of these waters being contacted by oil spills from the tanker lanes is a near certainty. The beaches and rocks used as haulout sites by California sea lions are many and widespread; therefore, there is also a high likelihood of one or more being contacted should a spill occur (86.5 percent conditional probability of contact). Northern elephant seals do not come and go daily from their haulout sites, nor do they forage close by. Typically, elephant seals remain on land for a month or more during the breeding season or for molting, and then disperse widely in the eastern North Pacific. They are most likely to be contacted at their colonies only when high surf can carry oil ashore; effects could be significant during the winter breeding season when pups might ingest oil during suckling. In the unlikely event of a tanker spill, the probability of contact to one or more northern elephant seal colonies is 37.8 percent. Northern fur seals breed on San Miguel Island in the Santa Barbara Channel and have a large pelagic population offshore in the winter and spring. The tanker lanes pass through waters used by northern fur seals and, consequently, the chance of contact with oil spills is very high. San Miguel Island is also at substantial risk from a tanker spill (Aspen Environmental Group 1992).

A spill from a tanker traveling along the outer coast would contact habitat used by dolphins and porpoises, and if it occurred when gray whales were migrating, the probability is very high that oil would contact the migration path. However, because of the widespread distributions of these animals and the lack of documented effects of historical oil spills, significant impacts are unlikely.

Rare/Threatened/Endangered Species

In this EIR, the impacts of spills from operations associated with the Long Wharf were analyzed for listed species which might be contacted by oil from a spill originating at the Long Wharf or Chevron tankers. Analysis of potential impacts was not done for sensitive species with a very low likelihood of contact because their primary occurrence is not within the tidal areas that could be affected by an oil spill associated with Long Wharf operations. Impacts to these species are considered adverse, but less than significant (Class III). The focus here is on sensitive species with populations in areas susceptible to a spill from Long Wharf operations.

Sensitive Plants

<u>Soft Haired Birds Beak (State Rare/Federal Endangered)</u>

Soft-haired birds beak is found in San Pablo Bay, Carquinez Strait, and Suisun Bay. The populations in southeast San Pablo Bay east of Point Pinole are at moderate risk from a spill at the Long Wharf. Oil contacted this area in 23 of the 100 modeled spill scenarios. In all but seven of those scenarios only trace amounts of oil contacted these marshes. All of the other areas where this species is known to occur are at low risk from a spill at the Long Wharf. Four of the five representative scenarios did not contact any populations of soft haired birds beak. The South-East San Pablo Bay scenario (#93) contacted populations at Point Pinole. The South-East San Pablo Bay scenario (#93) contacted populations at Point Pinole and Carquinez Strait. Therefore, under the wrong set of conditions, some populations of this listed species are at risk from a spill at the Long Wharf. If any population of soft haired bird's beak were harmed by oil, the results would be significant (Class I).

The Carquinez Strait population of soft haired birds beak would be most at risk from contact with oil if a spill occurred along tanker routes. Based on the analysis in the Unocal EIR, this population would have a 10 to 12 percent chance of medium oiling from a tanker spill. The population east of Pinole Point would have a 4 to 10 percent chance of moderate oiling from a tanker spill. The Tubbs Island population would have a 0 to 4 percent chance of moderate oiling from a tanker spill. Other populations of soft haired birds beak would have less than a 2 percent chance of moderate oiling.

None of the four applicable tanker spills modeled in the Unocal EIR contacted soft-haired bird's beak habitat.

Mason's Lilaeopsis (State Rare)

Mason's lilaeopsis is a brackish water species that is found up the Napa River, in the marshes north of Grizzly Bay, in eastern Suisun Bay, and in the Delta. The probability of oil from a spill at the Long Wharf contacting this species is relatively low. Based on the 100 spill scenarios from the Long Wharf, the westernmost populations at the Napa River have about a 10 percent chance of being contacted by greater than trace amounts of oil. The chances of a spill at the Long Wharf contacting any other population of Mason's lilaeopsis is negligible. None of the five spill scenarios analyzed in detail transported oil to areas where populations of Mason's lileopsis occur.

Based on the tanker spill analysis in the Unocal EIR, there would be a 0 to 4 percent chance of individuals of this species subjected to medium oiling from a tanker spill. None of the four representative tanker spill scenarios analyzed in the Unocal EIR resulted in oil contacting this species.

California Seablite (State Rare, Federal Endangered)

This species occurs at the southern end of the Bay in South Bay marshes and in the Delta. These areas are at negligible risk of contact from a spill at the Long Wharf. None of the oil spill scenarios showed oil from a Long Wharf spill extending into these areas.

The areas where California seablite is known to occur are also at low risk from a tanker spill. None of the four applicable tanker spill scenarios analyzed in the Unocal EIR resulted in oil contacting California seablite populations in the Delta. Scenario 11 of a 1,000-bbl spill from Anchorage 9, resulted in a California seablite population in South Bay being contacted with oil. Therefore, although the risk is low, a spill from a Chevron tanker could contact this species. If oil reached a population of California seablite, the impact would be significant (Class I).

Marsh Sandwort (State Endangered, Federal Endangered)

Marsh sandwort has been recorded near the Golden Gate. Based on the 100 modeled scenarios of a spill at the Long Wharf, oil from a spill has a very low chance of contacting this population. Less than 5 of the 100 scenarios resulted in greater than a trace amount of oil contacting this area. Oil did not reach the Golden Gate area in any of the five selected Long Wharf spills.

The Golden Gate area is at relatively high risk from a tanker spill because Chevron tankers pass through the Golden Gate regularly. The Unocal EIR analyzed four tanker spill scenarios that are applicable to Chevron tankers. Both scenarios of a 100,000-bbl tanker spill near Alcatraz contacted the area where marsh sandwort is found. Alternatively, neither of the 1,000-bbl spills from a tanker at Anchorage 9 contacted the marsh sandwort population. If oil contacted a population of this species, the impact would be significant (Class I).

Sensitive Fishes

Delta Smelt (Federal Threatened, State Threatened)

Delta smelt are found primarily in Suisun Bay. Suisun Bay is at almost no risk of contact by oil from a spill at the Long Wharf and at very low risk of receiving medium or greater doses of oil from a spill from Chevron tankers. None of the scenarios of a spill at the Long Wharf resulted in oil entering Suisun Bay.

The analysis in the Unocal EIR determined that the chance of medium or greater oil from a tanker spill entering Suisun Bay was less than 6 percent. None of the four applicable tanker spill scenarios analyzed in the Unocal EIR resulted in oil contacting Suisun Bay. However, if oil from Long Wharf operations did enter Suisun Bay, impacts to the Delta smelt population could be significant (Class I).

Chinook Salmon (Federal Endangered State Endangered)

Impacts to salmon were discussed above in the section on fishes. Young Chinook salmon, the life stage most vulnerable to an oil spill, are at moderate risk from a spill at the Long Wharf. The shallow water of the south side of San Pablo Bay, where they are most abundant, was contacted by a medium or heavy dose of oil in 7 of the 100 scenarios of a spill at the Long Wharf. Impacts to salmon in the five spill scenarios analyzed in detail ranged from less than 1 to almost 79 percent of the preferred habitat being contacted by the spill. Clearly under the wrong set of conditions, a spill at the Long Wharf could have a devastating impact on Chinook salmon (Class I). In the worst case, a spill could decimate a year class of salmon.

Based on the analysis in the Unocal EIR, the risk of a spill from tankers to Chinook salmon was determined to be moderate. Of the four applicable tanker spill scenarios analyzed in the Unocal EIR, three affected less than 1 percent of the preferred habitat of Chinook salmon. Scenario 9, a 100,000-bbl spill from a tanker near Alcatraz, contacted 41.6 percent of the preferred Chinook salmon habitat. Therefore, as was true of the Long Wharf spills, impacts to Chinook salmon from a tanker spill could range from highly significant (Class I) to negligible.

Steelhead (Federal Threatened)

Risk and impacts of an oil spill to steelhead that spawn in the Sacramento and San Joaquin Rivers and their tributaries (Central Valley Evolutionarily Significant Unit [ESU]) would be similar to those described above for Chinook salmon and could be substantial under certain conditions. Steelhead that spawn in creeks that enter San Pablo Bay, Central Bay, and South Bay (Central California Coast ESU) are at relatively high risk from a spill from Long Wharf operations because, since steelhead may spawn in streams throughout the estuary, there is a high probability that a spill would contact some habitat that may be used by young steelhead migrating from their natal streams to the ocean. Because this ESU includes steelhead that spawn in streams that enter the outer coast, only a small percentage of the population would be affected by any single spill. Because steelhead are listed as threatened, any oil spill that contacted their habitat would be a significant impact (Class I).

Sensitive Birds

California Clapper Rail (Federal/State Endangered) and California Black Rail (Federal Species of Concern/State Threatened)

As shown in Table 4.3-17, clapper rail habitat in Hoffman Marsh near Point Isabel is at high risk from a spill at the Long Wharf. Hoffman Marsh represents 3.3 percent of the clapper rail habitat in San Francisco Bay. Clapper rail habitat in Emeryville Lagoon and southeast San Pablo Bay is at moderate risk from a Long Wharf spill. These two areas represent a total of about 16 percent of the clapper rail habitat in San Francisco Bay. Based on the 100 spill scenarios at the Long Wharf, the remaining approximately 84 percent of clapper rail habitat in San Francisco Bay is at low risk of contact from a spill at the Long Wharf. Four of the five scenarios analyzed in detail contacted some clapper rail habitat, but none resulted in oil reaching more than 1 percent. In the South-East San Pablo Bay scenario (#93), no clapper rail habitat was contacted by oil. Therefore, a spill from the Long Wharf is likely to affect no more than a small percentage of the California clapper rail habitat in San Francisco Bay. Because California clapper rails are endangered, any oiling of its habitat would be a significant, adverse impact (Class I).

Most of the marshes inhabited by black rail are at low risk from a spill at the Long Wharf. However, black rails have been reported from marshes in southeast San Pablo Bay. Based on the 100 spill scenarios at the Long Wharf, these marshes have a moderate risk of being contacted by oil from a spill at the Long Wharf. As was true of the California clapper rail habitat, most black rail habitat in San Francisco Bay is at low risk from a spill at the Long Wharf. In three of the five spill scenarios analyzed in detail, a very small amount of marshes inhabited by black rail was contacted by the spill. Any impact to black rail habitat would be significant (Class I). The Berkeley-Emeryville scenario (#33) and the South-East San Pablo Bay scenario (#93) did not oil any marshes supporting black rails.

Based on the analysis in the Unocal EIR, spills from tankers have a more than 2 percent chance of contacting Sonoma Creek, and a 10 percent chance or more of contacting clapper rail habitat between Point Richmond and Oakland. Therefore, Emeryville marsh, which supports clapper rail but not black rail, is at high risk from a tanker spill. Marshes along the margins of San Pablo Bay, which support both clapper rail and black rail, are at moderate risk from a tanker spill. Combining all areas where birds occur, there is more than a 30 percent chance that oil spills from tankers would contact clapper rail habitat.

All of the four applicable tanker spills analyzed in the Unocal EIR contacted clapper rail habitat. Large tanker spills off Alcatraz Island contacted 2.4 and 1.3 percent of all clapper rail habitat in the Bays. The two scenarios of a 1,000-bbl spill from a tanker at Anchorage 9 contacted 6.1 and 5.6 percent of clapper rail habitat. Because the spills from Anchorage 9 contacted marshes in South Bay that do not support black rails, these spills would not affect their habitat. It is not known if clapper or black rails might be directly contacted by such oil spills, but even temporary habitat loss would have a significant, adverse effect on the health of these species (Class I).

California Least Tern (Federal/State Endangered)

The major least tern nesting colony at Alameda Point is at low risk from a spill at the Long Wharf. Only 7 of the 100 scenarios resulted in oil contacting the Alameda/Oakland area and the amount of oil was greater than trace in only 3 scenarios. None of the five detailed spill scenarios at the Long Wharf resulted in oil spreading as far south as Alameda.

Based on the analysis in the Unocal EIR, the active colony at Alameda Point is subject to risk of contact of 14.3 percent (high risk from a spill from tankers. All risk of contact to this site is produced by tanker transport in the traffic lanes from the Golden Gate to the Precautionary Area east of Alcatraz Island, and from there into northern San Francisco Bay.

Of the four applicable tanker spill scenarios analyzed in the Unocal EIR, two resulted in oil contacting waters near least tern colonies. Scenario 9 (100,000-bbl oil spill near Alcatraz Island) contacted waters adjacent to the active colony at Alameda Point and Scenario 10 also contacted this colony. These reasonable worst-case scenarios resulted in heavy contamination of waters that California least terns use for foraging. It is likely that some birds would be directly contacted, and also transfer oil to eggs or chicks at their nest. Substantial degradation of foraging habitat would occur as well. Impacts would be significant (Class I).

Long-Billed Curlew (California Species of Special Concern)

Long-billed curlews would be vulnerable to an oil spill because they forage primarily in intertidal mudflats. Probability of oil contacting habitat of long-billed curlews from spills at the Long Wharf or along the route of Chevron tankers is provided in the analysis of impacts to shorebirds, above. Contact with intertidal mudflats used for foraging by long-billed curlews occurs predominantly within San Pablo and South Bays. Mudflat habitat in southeast San Pablo Bay is at moderate risk from a spill at the Long Wharf. Mudflat in north and west San Pablo Bay is at low risk of being contacted by oil from a spill at the Long Wharf. Mudflat in the lower part of South Bay is at negligible risk from a Long Wharf spill. Table 4.3-20 estimates the percentage of the fall/winter long-billed curlew population in the tidal areas of San Francisco Bay that might suffer mortality in each of the five detailed spill scenarios. The most substantial impact would be from the West San Pablo Bay scenario (#91) that was predicted to result in mortality to 164 birds or 7.7 percent of the wintering population on the intertidal mudflats of San Francisco Bay.

Table 4.3-20
Percent Mortality of Long-Billed Curlew Population in San Francisco Estuary Contacted by Oil Spills at the Long Wharf

	Berkeley/ Emeryville #33	West Central Bay #68	Brooks Island/ Richmond #73	West San Pablo Bay #91	South-East San Pablo Bay #93
Percent Habitat Contacted	2.5	6.8	5.1	9.3	5.1
Number of Birds Killed*	44	120	90	164	90
Percent Wintering Population	2.1	5.6	4.2	7.7	4.2

*** Based on an estimated fall and winter population in San Francisco Bay of 2,128 birds (Chambers Group 1994) and an assumption that the percent mortality is directly proportional to the percentage of habitat contacted minus a 17 percent rehabilitation factor (i.e., 17 percent of the oiled birds are around to be rehabilitated).**

Based on the analysis in the Unocal EIR, the probability of intertidal mudflat habitat in San Pablo and South Bays being contacted by a spill from a tanker ranges from 0.2 to 10 percent. The four applicable tanker spills analyzed in the Unocal EIR resulted in a mortality between 8.5 and 14.4 percent of the seasonal long-billed curlew population in San Francisco Bay. Should such spills occur, impacts would be significant because of possible direct contact with birds, and certain loss of essential food resources on intertidal mudflats by oil contamination (Class I).

Double-Crested Cormorant (California Species of Special Concern)

Impacts to double-crested cormorants were discussed above under Birds. As shown in Table 4.3-17, the large double-crested cormorant colony on the Richmond-San Rafael Bridge is in the area at highest risk from a spill at the Long Wharf, and the largest colony on the Bay Bridge is in an area at moderate risk from a spill at the Long Wharf. Therefore, there is a high probability that waters used for foraging by birds from one or both of these colonies would be contacted by oil from a spill at the Long Wharf. If the spill occurred during the nesting season, the impacts to the double-crested cormorant population could be significant because breeding birds forage near their nests. In all of the five detailed scenarios of a spill, oil contacted the waters under the Richmond-San Rafael Bridge. In two of the scenarios (#33 and #73), oil contacted the water under both the Richmond-San Rafael Bridge and the Bay Bridge. Therefore, impacts of a spill at the Long Wharf are likely to result in significant impacts to double-crested cormorants (Class I).

Based on the analysis in the Unocal EIR, the probability of oil from tanker spills contacting either of these colonies is greater than 25 percent. Based on information cited in the Unocal EIR on the distribution and abundance of double-crested cormorants on the water in San Francisco Bay, the very large tanker spill near Alcatraz (Scenario 9) contacted 232 birds (40.3 percent of the population). Mortality might be less due to rescue of some oiled birds. However, mortality of adults might also result in loss of eggs and chicks should a spill occur during the breeding season. Loss to the regional population (i.e., birds in the San Francisco Bay estuary combined with those in the Gulf of the Farallones) could be as great as 10 percent from an oil spill and would constitute a significant impact (Class I).

California Brown Pelican (Federal/State Endangered)

California brown pelicans forage widely in deeper waters and can be contacted by spills in most parts of Central Bay and in San Pablo Bay. Major roost sites for California brown pelicans in San Francisco Bay are the Mare Island Breakwater, Sisters Rocks, Brothers Rocks, the Brooks Island Breakwater, Alameda Point and Hunters Point. Brothers Rocks is in the area at highest risk from a spill at the Long Wharf. The Brooks Island Breakwater is also in an area at high risk of being contacted by oil from a Long Wharf spill. The other major roosting sites are in areas with relatively low risk. In all of the five detailed spill scenarios, oil contacted the Brothers. In three of the spills (#68, #73 and #91), oil contacted the Sisters. In two of the spills (#33 and #73), oil contacted the Brooks Island Breakwater. None of the spills contacted the Mare Island Breakwater, Alameda NAS, or Hunter's Point. A spill at the Long Wharf could clearly result in mortality of brown pelicans and significant impacts (Class I).

The level of risk to major roosts of brown pelicans from a tanker spill in San Francisco and San Pablo Bays is shown in Table 4.3-21. There is a fairly high probability of contact with most major roosts from spills from tankers.

Table 4.3-21
Level of Risk of Contact with Major Roosts of Brown Pelicans in San Francisco and San Pablo Bays from Spills Along the Route Used by Tankers

Roost Site	Risk from Tankers
Mare Island Breakwater	H
Sisters Rocks	M
Brothers Rocks	M
Brooks Island Breakwater	H
Alameda Point	H
Hunters Point	L
L = Low risk (<1 percent chance) **M = Moderate risk (1 to 10 percent chance)** **H = High risk (>10 percent chance)**	

Based on the analysis in the Unocal EIR, the reasonable worst-case tanker spill scenario was Scenario 10. Scenario 10, a 100,000-bbl tanker spill east of Alcatraz Island in September, extensively contaminated the central and northern San Francisco Bay with moderate to heavy oiling, including the roost on the breakwater of Alameda NAS affecting 200 to 400 birds.

In summary, a large spill from a Chevron tanker could do more damage in the confines of the Bays than off the outer coast; however, it could also be more easily contained. Mortality of 400 birds in a northern California oil spill in the fall would constitute a loss of almost 0.5 percent of the breeding population of California brown pelicans. Spills from tankers, and to a less degree the Long Wharf, could produce significant impacts to California brown pelicans (Class I).

Common Loon (California Species of Special Concern)

The common loon is found in small numbers (<100) in deeper open water portions of the San Francisco Bay estuary in the winter; numbers migrating along the outer coast may reach several thousand during the spring. Numbers are declining due to loss of nesting habitat, oil spills, and mortality in gill nets. Based on the analysis in the Unocal EIR, reasonable worst-case oil spill scenarios showed that oil contact with common loons in the San Francisco Bay estuary resulted principally from large tanker spills; mortality ranged from 15.7 to 52.1 percent; a significant impact (Class I).

Barrow's Goldeneye (California Species of Special Concern)

The Barrow's goldeneye is a diving duck found in small numbers during the winter in open waters and salt and brackish marshes of the San Francisco Bay estuary. It is widespread in the area and subject to generally the same risk of contact as other waterfowl (i.e., near certainty). Based on reasonable worst-case scenarios, birds contacted by oil spills at the Long Wharf are expected to represent less than 2 percent of the population. However, large spills from tankers (Scenarios 9 and 10 in the Unocal EIR) have the potential to contact 27.7 to 42.9 percent of the population - a significant impact (Class I).

Aleutian Canada Goose (Federal/State Endangered)

Aleutian Canada geese are found in small numbers in shallow waters of San Pablo Bay and the South Bay; most occur in the Delta and Suisun Marsh, typically beyond the reach of oil spills. The risk of contact by oil spills is greatest in shallow waters of San Pablo Bay. Birds in this area are at moderate risk from a spill at the Long Wharf and at high risk from a spill from a tanker. The worst-case tanker spill analyzed in the Unocal EIR, a 100,000-bbl spill from a tanker near Alcatraz, was estimated to contact 12 to 14 birds. Because of their status as endangered, impacts to Aleutian Canada geese would be significant (Class I).

Sensitive Mammals

<u>Saltmarsh Harvest Mouse (Federal/State Endangered)</u>

The saltmarsh harvest mouse is endemic to salt and brackish marshes at scattered sites in Solano, Napa, Sonoma, Marin, Contra Costa, Alameda, and San Mateo Counties. Because this species is widely distributed in tidal marshes throughout the San Francisco estuary, it is likely that some portion of its habitat would be contacted by a spill at the Long Wharf or from a tanker servicing the Long Wharf. None of the scenarios analyzed for a spill at the Long Wharf resulted in more than 1.3 percent of the vegetated marsh habitat in the estuary being contacted. The worst-case tanker spill analyzed in the Unocal EIR (Scenario 9) resulted in contact of 8.8 percent of the species' habitat. The habitat of the saltmarsh harvest mouse is already greatly restricted in the San Francisco Bay estuary and loss of additional habitat from oil spills would constitute a significant impact (Class I).

Sensitive Species of the Outer Coast

All sensitive species that occur in tidal waters of the outer coast are at some risk of being contacted by oil should a spill occur from a Chevron tanker. Many endangered species are widely distributed in coastal waters and the probability that some portion of their habitat would be contacted by a large tanker spill is a near certainty. Species that are most likely to suffer population-level impacts are those with restricted distributions or with a large portion of their breeding population concentrated in a relatively small area.

The southern sea otter is at particular risk from an oil spill. Because sea otters rely on fur to keep warm, they are likely to die if their fur becomes oiled. A spill from a tanker off the central coast has a high probability of contacting a substantial portion of the population. Any spill contacting the sea otter range would almost certainly result in mortality of sea otters – a significant impact (Class I).

California brown pelicans in their breeding colonies on Ancapa Island and Santa Barbara Island have a substantial risk of contact by a spill from tankers in southern California (Aspen Environmental Group 1992). Over 80 percent of the California breeding population nests on Ancapa Island in the Santa Barbara Channel. Although the nests are on cliffs and not in danger of being contacted by oil, pelicans would be likely to become oiled when they dive for food.

Other sensitive bird species that breed at the Farallon Islands and the northern Channel Islands are also at substantial risk from a tanker spill. Based on the analysis in the Unocal EIR, the conditional probability of the Farallon Islands being contacted by crude oil spills is about 23 percent. The Farallon Islands have the most important colony of Ashy storm-petrels (80 percent of the world population of Ashy storm-petrels), a California Species of Special Concern. Prince Islet, off San Miguel Island, in the Santa Barbara Channel also has a large colony of this species and is at substantial risk from spill from tanker lanes in the Santa Barbara Channel (Aspen Environmental Group 1992).

There is a high probability that some portion of the habitat of the breeding population of the Steller sea lion will be contacted by oil from a tanker spill. The Unocal EIR determined that the probability that a Steller sea lion rookery or haulout would be contacted by a spill from a tanker traveling along the outer coast was almost 61 percent.

Summary of Oil Spill Impacts

An oil spill of 1,000 bbls or greater could have significant, adverse impacts on biological resources (Class I). A spill between 50 and 1,000 bbls would also probably have significant biological impacts that might not be avoidable (Class I). A spill between 1 and 50 bbls would also have significant impacts but could be contained and/or cleaned up before such impacts occurred (Class II).

Table 4.3-22 summarizes the analysis presented in the preceding discussion. The table lists the, biological resources in San Francisco Bay that are likely to suffer a significant, adverse impact (Class I) from Chevron's operation at the Long Wharf. This table includes the relative sensitivity of the resource to oil, the vulnerability of the resource within San Francisco Bay, and the relative risk from a spill at the Long Wharf or from a tanker servicing the Long Wharf. Sensitivity is an estimation of the extent to which the resource is likely to be harmed if contacted by oil. Vulnerability is the extent to which a large portion of the resource is within the area that is likely to be contacted by a spill from the Long Wharf or its tankers. Species that have a large portion of their populations outside of the Bay or in nontidal areas are less vulnerable to a spill than species such as the Delta smelt, with most of their population within the Bay. The risk is the probability that a substantial percentage of the resource would be contacted by an oil spill from the Long Wharf or one of its tankers. Clearly, given the wrong set of conditions, even a resource determined to be at low risk could suffer significant impacts from an oil spill at the Long Wharf. However, based on the analysis presented above, resources determined to be at low risk are unlikely to be contacted by a spill from Chevron operations. Species determined to be at moderate risk either have less than a 15 percent probability of any contact by medium or heavy doses of oil or their distribution is such that, although some portions of the resource might be at high risk, most of the resource is located in areas with a low probability of contact from a Chevron spill.

Based on the analysis, resources most likely to suffer substantial impacts from a spill at the Long Wharf include:

- Rocky intertidal habitat in the northern parts of Central Bay
- Juvenile Dungeness crabs
- Eelgrass beds
- Double-crested cormorants
- California brown pelicans

Table 4.3-22
Summary of Impacts to Resources Most Likely to be Significantly Affected by an Oil Spill from the Long Wharf Operations

Resource	Sensitivity[1]	Vulnerability[2]	Risk from Long Wharf[3] Spill	Risk from Tanker Spill
Plankton	L	H	L	M
Rocky intertidal	H	H	H	H
Intertidal mudflat	H	M	M	M
Dungeness crab	H	H	H	H
Eelgrass	H	H	H	M
Longfin smelt	M	H	M	M
Pacific herring	H	H	M	M
Chinook salmon	M	H	M	M
Striped bass	M	H	M	M
American shad	M	H	L	L
White sturgeon	M	H	M	M
Tidal marsh	H	H	M	M
Waterfowl	H	M	L	H
Shorebirds	M	M	M	M
Seabirds	M	M	M	H
Double-crested cormorant	M	H	H	H
Clapper rail	H	M	M	H
Harbor seals	M	M	M	M
Soft-haired birds beak	H	H	M	M
Mason's lilaeopsis	H	H	L	L
California seablite	H	M	L	L
Marsh sandwort	H	H	L	H
Delta smelt	M	H	L	L
Steelhead	M	M	M	M
Black rail	H	M	M	M
California least tern	H	M	L	H
Long-billed curlew	M	M	M	H
California brown pelican	H	M	H	H
Common loon	H	L	M	H
Barrows goldeneye	H	L	L	H
Aleutian Canada Goose	M	L	M	H
Saltmarsh Harvest mouse	H	M	M	M

[1] Sensitivity is the extent to which the resource is known to be harmed by oil spills.
[2] Vulnerability is the extent to which a large portion of the population is within the area that could be contacted by a spill.
[3] Risk is the probability that a substantial portion of the resource's habitat in San Francisco Bay will be contacted by a spill.

L = low
M = moderate
H = high

Resources most likely to suffer substantial impacts from a tanker spill include:

- Rocky intertidal habitat
- Juvenile Dungeness crabs
- Wintering waterfowl (if spill occurs in winter)
- Double-crested cormorant
- California clapper rails
- Marsh sandwort (if spill occurs near Golden Gate)
- California least tern
- California brown pelican

Other species, such as the saltmarsh harvest mouse, still might suffer a significant (Class I) impact from a Chevron oil spill because their status as listed species makes any contact by oil significant, but most of the population within the Bay would probably not be affected.

Resources at Risk from Oiling in the First 24 Hours Following a Long Wharf Spill and Ability for Rapid Response.

The results of the analysis described above as well as the time series of oil movement in the five representative scenarios of a spill at the Long Wharf (see Appendix B-1) were used to identify sensitive resources that could be oiled within the first 24 hours following a spill. In addition, Chevron's Spill Preparedness and Emergency Response Plan (Chevron 2005) provided further information on the speed with which oil spilled at the Long Wharf could reach sensitive resources. Finally, the Area Contingency Plan for the California North Coast, San Francisco Bay and Delta and Central Coast (USCG and OSPR 2000) was consulted for recommendations on how to protect those resources as well as area-wide preparedness to respond to a spill from the Long Wharf.

Based on the oil spill analysis done for this EIR as well as the analysis done by Chevron (2005), the resources at the most immediate risk of oiling from a spill at the Long Wharf are Castro Rocks and the Richmond eelgrass beds. The oil spill modeling done by Chevron indicates that a spill from the Long Wharf could reach these areas within 4 hours. The Area Contingency Plan describes specific methodologies and equipment to protect those areas by the placement of booms. For the Richmond eelgrass beds the plan recommends the strategic deployment of 6,000 feet of booms to protect eelgrass which is patchy in that area. For Castro Rocks, the Area Contingency Plan recommends placement of up to 9000 feet (1.7 miles) of boom to completely surround Castro Rocks.

Chevron's Emergency Response Plan (Chevron 2005) indicates that Chevron is well aware of the sensitivity of those resources. Chevron indicated that in the event of a spill, Chevron would place high priority on protecting Castro Rocks and Brooks Island (D. Kinkela, Chevron, personal communication, 2002). Chevron's first response would be to consider the currents at the time of the spill and to protect whichever of these areas was in the direction of the prevailing current. It should be considered, however, that tidal currents switch direction about every 6 hours. Therefore, oil headed towards Brooks Island may be directed toward Castro Rocks when the tide changes. Although Chevron is aware of the Richmond eelgrass beds as a sensitive resource with high priority for protection, it does not appear that a particular plan is in place to determine exactly how to protect those beds or that drills are done to deploy booms in the appropriate areas to protect eelgrass.

According to the Chevron Plan, Chevron has approximately 12,500 feet (2.4 miles) of boom at the Long Wharf. This boom may not be adequate to protect all the resources (Castro Rocks, Richmond eelgrass beds, Brooks Island) at immediate risk from a spill at the Long Wharf. Also, in the event of a large Long Wharf spill it may be crucial to simultaneously boom Castro Rocks and the Richmond eelgrass beds, resources that could be reached by oil in a few hours. It does not appear that Chevron has prepared for the rapid deployment of as much as 15,000 feet (2.8 miles) of boom.

The Castro Creek marshes, northeast of San Pablo Point, are at high risk from a spill from the Long Wharf when oil transport is northeasterly. The oil spill scenarios done for this EIR as well as the analysis in Chevron's Plan indicate that oil could reach this area within 24 hours, but probably not within the first 8 to 12 hours following a spill. The Area Contingency Plan recommends deploying 3,200 feet (0.6 miles) of harbor boom from the Pt. San Pablo Yacht Harbor to protect these marshes. This area may be best protected by MSRC rather than by Chevron, but Chevron should demonstrate that either MSRCor Chevron equipment can be mobilized and deployed to protect these marshes within 12 hours.

Finally, the scenarios developed for this EIR indicate that, under certain conditions, mudflats and marshes along the eastern shore of San Pablo Bay may be contacted by oil from the Long Wharf within 12 to 24 hours. The analysis in the Chevron Plan shows these marshes as being contacted within 48 hours. The Area Contingency Plan does not contain a strategy or equipment to protect the San Pablo Creek marshes. The Area Contingency does have a plan for protecting the Pinole Pt. marshes but the document states that the strategy has not been deployed or tested. Chevron should work with Clean Bay to test the deployment of equipment to protect these marshes.

Finally, double crested cormorants that nest on the Richmond-San Rafael Bridge are at especially high risk of contact with oil from a spill at the Long Wharf as they forage for food in Bay waters near their nesting site. Chevron should develop a plan approved by CDFG to flush cormorants from the area and also should have plans to procure qualified specialists to capture and rehabilitate oiled birds as quickly as possible.

Mitigation Measures for BIO-6:

The following mitigation measures shall be implemented by Chevron to mitigate oil spill impacts to the maximum extent feasible:

BIO-6a. Implement MM OS-3a through MM OS-3d and MM OS-4 in Operational Safety/Risk of Accidents to either lower the probability of an oil spill or increase response capability.

BIO-6b. Chevron shall demonstrate to the satisfaction of the California State Lands Commission (CSLC) that the Long Wharf can successfully implement its Oil Spill Response Plan and can deploy within 3 hours all the boom necessary to simultaneously protect all the sensitive resources at risk of contact with oil within 3 hours from a spill at the Long Wharf. Sensitive resources close to the Long Wharf include Castro Rocks, eelgrass beds, and the double-crested cormorant breeding colony on the Richmond-San Rafael Bridge. Procedures for the protection of Castro Rocks and eelgrass beds are detailed in the Area Contingency Plan (USCG and OSPR 1997). Chevron shall obtain the 15,000 feet (2.8 miles) of boom necessary to protect the Richmond eelgrass beds and Castro Rocks simultaneously from a spill at the Long Wharf. Chevron shall survey for eelgrass annually in the Richmond area and identify the places where substantial amounts of eelgrass currently grow. Chevron shall implement drills specifically designed to deploy and anchor booms simultaneously to protect immediately Castro Rocks and the Richmond eelgrass beds from oil. Because a spill could reach these areas rapidly, Chevron should have immediate access to the equipment and personnel detailed in the Area Contingency Plan.

BIO-6c. Procedures should be in place to flush double-crested cormorants from the waters contaminated by oil. Arrangements should be made to quickly bring expert bird rehabilitators to the site to rescue oiled birds.

BIO-6d. Chevron shall ensure that adequate equipment and personnel are available to protect the Castro Creek marshes, San Pablo Creek marshes, Pinole Pt. marshes and the southeastern San Pablo Bay mudflats within 8 hours of a spill at the Long Wharf. The strategy to protect each of these sensitive resources shall be tested with a field demonstration of deployment and placement of booms and other equipment in locations designated in the Area Contingency Plan to protect these sensitive habitats.

BIO-6e. When a spill occurs, develop procedures for clean up of any sensitive biological areas contacted by oil, in consultation with biologists from California Department of Fish and Game and United States Fish and Wildlife Service, to avoid damage from clean up activities.

BIO-6f. If damage occurs, the last resort is restoration and compensation. Any loss of resources shall be documented as soon as possible after a large spill. The sampling methods and design should be determined beforehand, and the plan should include provisions for getting resources onsite as soon as possible so that post-spill studies can begin immediately.

BIO-6g. Chevron shall implement MM OS-7a and MM OS-7b in Operational Safety/Risk of Accidents addressing potential participation in VTS upgrade evaluations, and Chevron response actions for spills at or near the Long Wharf.

Rationale for Mitigation: Containment of small spills and protection of sensitive resources may reduce biological impacts to less than significant (Class III) for small spills. For large spills, significant impacts are likely. Sensitive areas that could be impacted within three hours of a spill are the greatest concern for immediate protection. These sensitive areas include Castro Rocks, eelgrass beds, and the double-crested cormorant breeding colony on the Richmond-San Rafael Bridge Implementing MM OS-3 through MM OS-6 help increase response capability and reduce risk of accidents. Chevron has approximately 12,500 feet (2.4 miles) of boom at the Long Wharf. This amount of boom appears to be inadequate to simultaneously protect Castro Rocks and eelgrass beds in the event of a spill at the Long Wharf. In addition, Chevron does not have specific procedures to protect eelgrass beds in the immediate vicinity of the Long Wharf. Implementing MM BIO-6b will insure that Chevron is adequately prepared to protect the sensitive resources most immediately at risk from a spill at the Long Wharf. Chevron does not have a specific plan to deter double-crested cormorants from foraging in oiled areas should a spill occur. MM BIO-6c would insure that Chevron develops procedures and has inplace expert bird rehabilitators to protect double-crested cormorants in case of a spill at the Long Wharf. MM BIO-6d ensures that equipment and personnel are available to protect the marshes by demonstrating to CSLC that the Long Wharf has the equipment and personnel to deploy protection within 8 hours of a spill. MM BIO-6e insures that consultation for cleanup actions with CDFG and USFWS will occur to avoid damage that can occur during cleanup operations. MM BIO-6f requires the immediate documentation of any damage from oil spills, which is critical to the determination of compensation; and insures that sampling methods and design are planned as soon as a spill occurs so that further damage will not occur and so that post spill studies can commence; and provides a means to determine the effectiveness of documentation. MM BIO-6e and MM BIO-6f both provide information for the continued evaluation of the effectiveness of cleanup actions and appropriate methods of cleanup and methods of data collection.

Response capability for containment and cleanup of vessel spills while transiting the Bay or outer coast is not Chevron's responsibility. Nevertheless, as a participant in any analysis to examine upgrades to the VTS (MM OS-7a), Chevron can help to improve transit issues and response capabilities in general which help to reduce the consequences of spills within the Bay. For a spill near the Long Wharf, Chevron is more suited to provide immediate response (MM OS-7b) to a spill using its own equipment and resources, rather than waiting for mobilization and arrival of the vessel's response organization. The Long Wharf staff is fully trained to take immediate actions in response to spills. Such action will result in a quicker application of oil spill equipment to any spill and improve control and recovery of such spill. Impacts to biological resources from spills near the Long Wharf caused by transiting vessels may be able to be reduced to less than significant with containment by Chevron with implementation of MM OS-7b.

<u>Residual Impacts</u>: For large spills, oil is likely to contact sensitive resources and impacts would remain significant (Class I) even with mitigation.

4.3.5 Impacts of Alternatives

BIO-7: No Project Alternative

The alternative would eliminate the biological resources impacts associated with operations at the Long Wharf resulting in a beneficial (Class IV) impact. Biological resources impacts (Class I, II and III) would be transferred to other marine terminals and would be similar to the proposed Project. Chevron has no responsibility for these other terminals.

Under the No Project Alternative, Chevron's lease would not be renewed and the existing Long Wharf would be subsequently decommissioned with its components abandoned in place, removed, or a combination thereof. The decommissioning of the Long Wharf would follow an Abandonment and Restoration Plan as described in Section 3.3.1, No Project Alternative.

Under the No Project Alternative, alternative means of crude oil / product transportation would need to be in place prior to decommissioning of the Long Wharf, or the operation of the Chevron Refinery would cease production, at least temporarily. It is more likely, however, that under the No Project Alternative, Chevron would pursue alternative means of traditional crude oil transportation, such as a pipeline transportation, or use of a different marine terminal. Accordingly, this EIR describes and analyzes the potential environmental impacts of these alternatives. For the purposes of this EIR, it has been assumed that the No Project Alternative would result in a decommissioning schedule that would consider implementation of one of the described transportation alternatives. Any future crude oil or product transportation alternative would be the subject of a subsequent application to the CSLC and other agencies having jurisdiction, depending on the proposed alternative.

During decommissioning, removal of the Long Wharf would cause temporary impacts to biological resources due to the noise and activity associated with pier removal operations and by disturbance of sediments during pier removal. These impacts would be short lived and are considered adverse but less than significant (Class III).

Following decommissioning, the impacts to biological resources in San Francisco Bay from operations of the LongWharf would be eliminated. These impacts include disturbance of vessel traffic and maintenance dredging, the risk of introduction of exotic species in ballast water, the chronic input to Bay waters of small amounts of contaminants, and the risk of an oil spill at the Long Wharf.

The transfer of tanker traffic from the Long Wharf to another marine terminal would eliminate impacts to biological resources from operations at the Long Wharf but would transfer some of the impacts to another site. Because the additional tanker traffic at another marine terminal would not be expected to increase needed maintenance dredging at the other terminal or small chronic input of contaminants from storm runoff, this alternative would have slightly fewer operational impacts to biological resources than continued operations at the Long Wharf.

Biological impacts associated with vessels would be transferred to another marine terminal and would be similar to the proposed Project. These impacts include disturbance to biological resources from boat traffic, sediment disturbance generated by boat propellers and bow thrusters, introduction of exotic organisms in ballast water discharges and by hull fouling, and introduction of toxins used as anti-fouling agents on tankers. The potential impacts of spills on biological resources would depend on the location of the other terminal. Biological resources in close proximity to the Long Wharf would be at greatest risk from an oil spill at the Long Wharf. The potential impacts of a spill from a tanker would be similar to the proposed Project.

<u>BIO-7: No mitigation is required.</u>

Impact BIO-8: Full Throughput via Pipeline Alternative

The alternative would eliminate the biological resources impacts associated with Long Wharf operations at the Long Wharf resulting in a beneficial (Class IV) impact. Biological resources impacts (Class I, II and III) would be transferred to other marine terminals and would be similar to the proposed Project. Chevron has no responsibility for these other terminals. Biological resources would be disturbed by the construction of new pipelines (Class I and II).

With this alternative, the impacts to biological resources in San Francisco Bay from operations of the Long Wharf would be eliminated. These impacts include disturbance of vessel traffic and maintenance dredging, the risk of introduction of exotic species in ballast water, and the chronic input to Bay waters of small amounts of contaminants.

Construction of new pipelines to transport oil and products to and from the Refinery would disturb biological resources along the new pipeline routes. If sensitive biological resources are present along the new routes, the impacts of construction could be significant (Class I and II). A variety of mitigation measures, including avoidance of sensitive habitat, boring pipelines under sensitive streambed and wetland areas, and limiting construction to seasons when sensitive resources are not present, are available. Depending on the pipeline routes, mitigation measures may or may not be effective in reducing impacts of pipeline construction to a level of less than significant.

The impacts of oil spills from a pipeline would probably be less than from a spill at the Long Wharf. If the spill occurred on land, oil would be transported less rapidly than a spill in San Francisco Bay, and the spill would be more easily contained. Impacts to biological resources could still be significant, however (Class I or II). The worst-case spill from a pipeline would most likely be if oil was spilled into a river or creek. The oil could contaminate a substantial amount of habitat if it was not rapidly contained.

Mitigation Measures for BIO-8:

BIO-8a. Chevron shall perform biological surveys of proposed pipeline routes and if any sensitive resources are identified along the route, Chevron shall prepare and implement a mitigation plan to avoid impacts to those resources.

BIO-8b. Chevron shall develop a plan to contain spilled oil and protect sensitive biological resources in the event of an oil spill.

Rationale for Mitigation: A variety of mitigation measures, including avoidance of sensitive habitat, boring pipelines under sensitive streambed and wetland areas, and limiting construction to seasons when sensitive resources are not present, are available. Implementation of appropriate measures would reduce or eliminate impacts to sensitive resources. A protection plan addressing emergency containment actions would result in an increase in response capability. Small spills that can be quickly contained may be mitigated to less than significant.

Residual Impacts: Depending on the pipeline routes, mitigation measures may or may not be effective in reducing impacts of pipeline construction to a level of less than significant. Impacts may remain significant (Class I). Even with the implementation of protection and containment procedures, significant biological impacts (Class I) could still occur in the event of a large spill.

Impact BIO-9: Conceptual Consolidation Terminal Alternative

This alternative would reduce the impacts of routine operations at the Long Wharf. However, because operations would continue at the Long Wharf, the impacts to biological resources of routine operations would be similar to the proposed Project. Berths would still need to be maintained by maintenance dredging, although fewer berths may be necessary and the amount of dredging required on an annual basis might be reduced. Localized disturbance from routine operations at a consolidated terminal would be similar to those described for the Long Wharf. Impacts of ballast water discharge (Class I) and of dredging on Chinook salmon and Dungeness crab (Class II) would be potentially significant at both the Long Wharf and the consolidated terminal locations.

The probability of an oil spill from Long Wharf operations would be reduced at the Long Wharf and increased at the consolidated terminal in San Pablo Bay. The risk to biological resources if a spill did occur at the Long Wharf would be the same as that described for the proposed Project. The likely impacts of a spill at the Long Wharf would be similar to those described for the five Long Wharf spill scenarios analyzed in detail.

For the portion of oil and products transported to and from the consolidated terminal, risk from a spill would be reduced for resources in Central Bay and increased for resources in San Pablo Bay. Therefore, eelgrass beds, the rocky intertidal habitat in Central Bay, and double-crested cormorants would be less likely to be substantially affected from a spill at the consolidated terminal compared to a spill at the Long Wharf. However, sensitive resources in Carquinez Strait and Suisun Bay would be at slightly greater risk from a spill at a consolidated terminal compared to a spill at the Long Wharf. However, based on the analysis of a terminal in north San Pablo Bay in the Unocal EIR, the risk to Suisun Bay from a terminal spill would still be low. Because large amounts of intertidal mudflat and vegetated marsh occur along the perimeter of San Pablo Bay, a higher percentage of marsh and mudflat habitat is likely to be contacted by oil from a spill at the consolidated terminal than a spill at the Long Wharf.

The impacts to biological resources from an oil spill from tankers servicing a consolidated terminal would be the same as those described for the proposed Project because it was assumed that tankers visiting the Long Wharf could travel in any of the routes used by tankers in the Bay and along the outer coast. Impacts from an oil spill with the Conceptual Consolidation Terminal Alternative could remain significant and not fully mitigable (Class I).

Construction of new pipelines to transport oil and products to and from the Refinery would disturb biological resources along the new pipeline routes. If sensitive biological resources are present along the new routes, the impacts of construction could be significant (Class I and II). A variety of mitigation measures, including avoidance of sensitive habitat, boring pipelines under sensitive streambed and wetland areas, and limiting construction to seasons when sensitive resources are not present, are available. Depending on the pipeline routes, mitigation measures may or may not be effective in reducing impacts of pipeline construction to a level of less than significant.

Mitigation Measures for BIO-9:

BIO-9. To protect biological resources from disturbance by pipeline construction and oil spill impacts implement measures MM BIO-8a and MM BIO-8b.

Rationale for Mitigation: For any pipelines that Chevron would use or share use of, a protection plan addressing emergency containment actions would result in an increase in response capability. Small spills that can be quickly contained may be mitigated to less than significant.

Residual Impacts: Depending on the pipeline routes, mitigation measures may or may not be effective in reducing impacts of pipeline construction to a level of less than significant. Impacts may remain significant (Class I). Even with the implementation of protection and containment procedures, significant biological impacts (Class I) could still occur in the event of a large spill.

4.3.6 Cumulative Projects Impacts Analysis

Impact CUM-BIO-1: Routine Operations

Operations at the Long Wharf could contribute to the cumulative adverse impacts to biological resources from the introduction of non-indigenous organisms. These potential impacts include competition, destabilization of the aquatic food web, accumulation of contaminants in the tissues of non-native prey species such as the Asian clam, and introduction of disease microorganisms or toxic algae. These are cumulatively significant adverse impacts (Class I) and Long Wharf's contribution to the cumulative potential for introduction of non-indigenous species through ballast water discharges or hull fouling could be considerable. Chevron also would contribute in a minor way to the cumulative degradation of water quality in San Francisco Bay. Impaired water quality in San Francisco Bay is a significant adverse impact (Class I). Disturbance to the benthic community by vessels in shipping channels has altered the benthic community in these areas (Class I impact). Chevron would contribute in a minor way to this significant impact. Dredging at the Long Wharf could contribute to potentially significant but mitigable impacts on migration and spawning (Class II). Other contributions from routine operations at the Long Wharf to cumulative impacts on biological resources would be less than significant (Class III)

Routine Operations

Plankton

Plankton populations in the San Francisco Bay estuary have been subjected to cumulative impacts from decreases in freshwater outflow from the Delta, introduction of exotic species, and degradation of water quality from inputs of contaminants. Plankton may also be affected temporarily by operations such as dredging and marine construction which generate turbidity. However, turbidity would be localized in space and time. Turbidity impacts would only be cumulative if two or more major projects were generating large areas of turbidity within the same Bay at the same time.

Maintenance dredging near the Long Wharf generates limited turbidity once a year and is not expected to contribute to cumulative impacts on plankton populations. Operations at the Long Wharf would also not contribute to cumulative impacts on plankton from decreases in freshwater outflow. However, the discharge of segregated ballast water, even after mid-ocean exchange, could contribute to impacts from introduction of exotic species. Voracious filter feeding by the introduced Asian clam, *Potamocorbula amurensis*, has contributed to marked declines in phytoplankton populations in the northern reach (especially in Suisun Bay). Introduced zooplankton species, such as the copepods *Sinocalanus doerri* and *Pseudodiaptomus forbesi*, are thought to have contributed to the declines of native species such as *Eurytemora affinis* and *Diaptomus*.

The cumulative impacts from the introduction of exotic species have been highly significant to the native plankton assemblages of the San Francisco estuary. Approximately 400 tanker calls per year are made to the Long Wharf. The average volume of ballast water discharged by a tanker is estimated to be 2.5 million gallons (Cohen 1998). Therefore, tankers calling at the Long Wharf may discharge as much as 1,000 million gallons of ballast water per year. The total amount of ballast water discharged to San Francisco Bay in a year is estimated to be between 2.5 and 5 billion gallons. Therefore, if all the tankers visiting the Long Wharf discharged their ballast water into San Francisco Bay, Chevron tankers could be responsible for as much as 20 to 40 percent of the annual ballast water discharge. The contribution of Chevron tankers to annual ballast water discharges may be substantial. The potential to introduce additional exotic species to San Francisco Bay is a significant cumulative impact. The cumulative impact of contaminants input to San Francisco Bay is significant (Class I).

The release of contaminants associated with the Long Wharf would contribute to degradation of water quality within the Bay. Levels of many contaminants in the water column, the sediments, and the biota of the San Francisco Bay estuary are at levels found to have harmful effects on aquatic organisms. It is not known if contaminant levels have affected plankton populations. Operations at the Long Wharf would contribute slightly to the levels of these contaminants, but the Long Wharf's contribution to mass loadings of these contaminants is much less than other sources, such as industrial discharges and storm runoff. Therefore, Chevron would contribute to the cumulative impacts of degradation of water quality on planktonic organisms, but that contribution would be small compared to other sources. The cumulative impact of contaminant input to San Francisco Bay is significant (Class I).

Benthos

Cumulative impacts on the benthos from routine operations could occur from disturbance of sediments in ship channels, and during dredging, introduction of exotic organisms in ballast water and inputs of contaminants in sediments.

Benthic invertebrate communities in the ship channels are marked by a lower abundance and diversity than communities in less disturbed areas. The depauperate communities in the shipping lanes are probably related to the frequent disturbance of the sediments by the wakes and propellers of large vessels, as well as by periodic maintenance dredging. Therefore, the disturbance to the shipping channels within San Francisco Bay has altered the diversity and abundance of benthic invertebrate populations and is a significant impact (Class I). Tankers and barges traveling to and from the Long Wharf represent less than 2 percent of the annual vessel traffic in San Francisco Bay. Therefore, the contribution that operations at the Long Wharf make to impacts of navigation channels on benthic communities is small.

Operations at the Long Wharf could contribute to the introduction of exotic species if ballast water was discharged. The potential adverse impacts of invasive species, should any be introduced, could be highly significant and would occur in a vulnerable environment because of cumulative impacts from previous invasions and other disturbances (Class I). Furthermore, Chevron's contribution to the annual volume of ballast water discharged in the Bay could be substantial.

Annual maintenance dredging would disturb the sediments at the dredge site near the Long Wharf and at the Alcatraz disposal site. Dredging activities would contribute to the disturbance of benthic communities in these areas. Communities in the berths at the Long Wharf are constantly disturbed by dredging. Without dredging, it is possible that benthic communities would be able to increase in diversity and accommodate some species other than opportunistic early invaders. Therefore, dredging at the Long Wharf may act in a cumulative manner with other disturbances in San Francisco Bay to favor low diversity and opportunistic species. Because dredging only affects the benthos in a limited area, the cumulative effect of maintenance dredging by Chevron on benthic communities would be adverse, but less than significant (Class III). The disposal of dredged sediments at the Alcatraz disposal site would contribute to the continual disturbance of the benthos in that area. Past disposal of dredged materials at the Alcatraz site has created mounds and altered the nature of the sediments and associated benthic communities (Segar 1988; USACE, EPA, BCDC, SF-RWQCB and SWRCB 1998). Currently, annual discharges to the site are limited to a total of 4 mcy. Limitations on the annual volume of discharge may reduce future impacts at the Alcatraz site to adverse, but less than significant (Class III). Chevron's contribution to the annual discharge at the site is about 9 percent.

Sediments in San Francisco Bay exceed levels at which effects to benthic organisms can occur in many locations. Contaminants in sediments may be contributing to the degraded condition of benthic communities within San Francisco Bay. The

San Francisco Estuary Institute recently conducted a pilot study to identify the degree of contaminant impacts to benthic assemblages in the San Francisco estuary (Lowe and Thompson 1999). The benthic assessments identified two samples from Stege Marsh in the eastern Central Bay that were severely contaminated and showed that several San Leandro Bay samples were considered to be moderately affected by contamination. Most benthic assemblages in the study area did not appear to be highly degraded by contamination. Therefore, the cumulative impacts of contamination on benthic populations in San Francisco Bay appear to be significant only in localized areas. Contaminant levels in sediments near the Long Wharf are similar to levels in sediments throughout San Francisco Bay. The effects of chronic contamination from Long Wharf operations to cumulative impacts of contamination on benthic communities in San Francisco Bay are adverse, but less than significant (Class III).

<u>Fishes</u>

The fish populations in the San Francisco Bay estuary have been altered by the cumulative impacts of overfishing, loss of habitat, introduction of exotic species, decreased Delta outflows, and increases in contaminants (Nichols et al. 1986). Of these major factors affecting fish populations in the Bay, operation of the Long Wharf would only contribute directly to increases in contaminants. However, any stresses on fish populations as a result of Long Wharf operations would affect fish populations already stressed by the other factors. Operations at the Long Wharf would also contribute to the cumulative impacts of maintenance dredging and vessel noise on fish populations. The cumulative impacts of these activities appear to be minor. Noise from large vessels can startle fishes and cause avoidance behavior. Within the San Francisco Bay estuary, with its constant background of vessel noise, fishes have probably adapted to the regular noise of large vessels. Fishes have been documented to avoid dredge disposal areas during disposal events. The area affected is small, however, and disposal events occur during a brief time period. On a cumulative level, dredging and dredge material disposal would have an adverse, but less than significant impact on fishes (Class III).

The evidence suggests that contaminant loads may be significantly affecting fish populations in San Francisco Bay. Fishes within the San Francisco Bay estuary have been documented to show liver abnormalities which are thought to be related to elevated levels of contaminants (San Francisco Bay Estuary Project 1992). Recent studies of contaminant levels in fishes in San Francisco Bay showed that fishes collected in 1994, 1997 and 2000 had very high levels of several contaminants, including mercury, PCBs, dieldren, DDT, and chlordane (Davis et al. 1999, Greenfield et al. 2003). None of these contaminants is likely to be associated with operations of the Long Wharf. Pollutants have been implicated in the decline of the striped bass (Whipple et al. 1987). As discussed, operations at the Long Wharf may be contributing small quantities of contaminants to add to pollutant stresses on fishes in the San Francisco Bay estuary. The Long Wharf's contribution to contaminant loads is extremely small relative to other sources. While this contaminant input by itself would present a small yet significant adverse impact on fishes of the San Francisco Estuary (Class I), the overall contaminant loading to the Estuary from all sources is substantial and will significantly affect the fish populations of San Francisco Bay.

Operations at the Long Wharf could contribute to the cumulative adverse impacts to fishes from the introduction of non-indigenous species. These potential impacts include competition from non-native fishes, destabilization of the aquatic food web, accumulation of contaminants in the tissues of non-native prey species such as the Asian clam, and introduction of disease microorganisms or toxic algae. These impacts are cumulatively significant (Class I) and Chevron's contribution to the cumulative potential for introduction of non-indigenous species through ballast water discharges or hull fouling could be substantial.

Marshes

Marshes in the San Francisco Bay estuary have been lost and severely degraded by diking, filling, flood control, and the indirect impacts of development. Routine operations at the Long Wharf would not contribute to cumulative impacts on saltmarsh habitat.

Avifauna

Routine operations of the Long Wharf would produce noise and human activity, and some discharges affecting local water quality. To some extent, all of these factors influence the distribution and present patterns of abundance of seabirds, shorebirds, and waterfowl. Typically, birds common near marine terminals are those most tolerant of noise and human activity. These include nesting western gulls, several other species of gulls that roost on or near marine terminals, occasionally brown pelicans, blackbirds, and other passerines.

Western gulls nest in substantial numbers on the wharves of the Conoco/Philips Marine Terminal at Davis Point, on the Brothers Rocks directly off the PAKTANK Terminal, on Red Rock within 1 km of the Long Wharf, on the Long Wharf itself, on the Brooks Island breakwater near the Port of Richmond, and on the piers of the San Francisco Port Marine Terminals. Providing that they are not intruded upon, western gulls are apparently tolerant to some degree of noise and human activity at terminals and ports. Therefore, routine operations of these terminals are expected to have adverse, but less than significant impacts on this species (Class III).

Scoters and ducks typically forage or rest in the shallow waters of the Bays rather than in deeper waters. They are uncommon in the fast currents of the ship channel and are not likely to be affected by slow-moving tanker traffic. They are low in abundance in the immediate vicinity of all marine terminals in the Richmond area, Conoco/Philips, near the Carquinez Strait, and in the Martinez-Benicia area. The few present would not be subject to mortality or habitat loss due to normal activities associated with vessel calls and transfer of oil or petroleum products. Although routine operations could produce adverse impacts, these would be adverse, but less than significant because of the small number of birds that might be affected (Class III).

Discharges from marine terminals may affect local water quality, ultimately contributing to deterioration in habitat and contamination of fish and invertebrate food resources consumed by birds. These discharges, like those of other industrial activities in the Bays, are regulated by the RWQCB. Pollutants found in especially high concentrations in scoters and ducks include selenium, silver, copper, mercury, zinc, and cadmium. These metals are contained in the mussels, clams, and other benthic organisms consumed by waterfowl, and are the accumulation of many years of discharges from a variety of sources. The cumulative impact of contaminant discharges on avifauna is considered significant (Class I). However, the Long Wharf's contribution to cumulative contaminant levels in San Francisco Bay is relatively small.

Operations at the Long Wharf could contribute to the cumulative adverse impacts to water-associated birds from the introduction of non-indigenous species. These potential impacts include destabilization of the aquatic food web, accumulation of contaminants in the tissues of non-native prey species such as the Asian clam, and introduction of disease microorganisms or toxic algae. These impacts are cumulatively significant (Class I) and Chevron's contribution to the cumulative potential for introduction of non-indigenous species through ballast water discharges or hull fouling could be substantial.

Marine Mammals

The possibility exists for injury or death of harbor seals or harbor porpoises due to collisions with vessels. If impacts occurred, they would be significant because both species are protected under the Marine Mammal Protection Act of 1972. There have been few reported instances of collisions of large vessels with these agile marine mammals anywhere in their range. It is unlikely that a harbor seal or harbor porpoise would be struck by a slow-moving tanker. Because of the negligible chance of occurrence, the impacts of collision with the marine mammals in the Bays from normal vessel traffic would be adverse, but less than significant (Class III).

Harbor porpoises are predominantly seen in waters near the Golden Gate and east to about Alcatraz Island. Because of their distribution, they are unlikely to be affected by discharges at marine terminals, including those that affect local water quality. Harbor seals are also rare in the immediate vicinity of marine terminals and unlikely to be affected by discharges. Although cumulative discharges certainly deteriorate water quality (an adverse impact), the measurable impact on marine mammals would be adverse, but less than significant (Class III).

Marine mammals not listed as threatened or endangered that occur off the outer coast include sea lions, fur seals, elephant seals, harbor seals, Dall's porpoise, harbor porpoise, and three species of dolphins. These species and others are known to be common in waters used to transport crude oil and oil products. To some extent, all are subject to death or injury from collision with tankers in the Gulf of the Farallones and along the north coast. However, the probability of contact is extremely remote, considering the speed of movement and agility of these species. Potential impacts of collisions of cumulative tanker traffic with nonlisted marine mammals are considered adverse, but less than significant (Class III).

Rare/Threatened/Endangered Species

Chinook salmon occur in the immediate vicinity of the Long Wharf. Contaminants associated with the Long Wharf are unlikely to contribute to the body burden of young salmon, because individuals would only remain near the Long Wharf for a short while before they migrate to the ocean. Because salmon spend their adult lives off the open coast, they are not subjected to the high level of contaminants in San Francisco Bay for more than a short while; therefore, the cumulative impact of contaminants on Chinook salmon would be adverse, but less than significant (Class III). Dredging operations at the Long Wharf or elsewhere in the Bay could interfere with the movement of young salmon from the Delta to the ocean. Interference with the outmigration of young salmon is a potentially significant impact (Class II). Impacts could be reduced to less than significant by restricting dredging to June through November when winter and spring run smolt activity is lowest.

No rare, threatened, or endangered bird species typically occur in the immediate vicinity of marine terminals in the Bay, except for the California brown pelican (federal andState endangered), which uses the San Francisco Bay estuary in late summer and fall. California brown pelicans are known to roost in small numbers at sites throughout the area (generally pilings and breakwaters at some distance from sources of disturbance). Sites near marine terminals used for roosting by substantial numbers of birds include the Brothers Rocks off the PAKTANK Terminal, the Brooks Island breakwater off the Port of Richmond, and the Alameda NAS breakwater off the Ports of Oakland/Alameda. Presumably, pelicans roosting near marine terminals are accustomed to noise and activity from routine operations; therefore, any impacts would be minor and less than significant (Class III).

Endangered least terns have an important colony at Alameda Point. This colony has nested successfully in recent years in spite of high vessel activity in the area. Alameda Point is not near the Long Wharf and routine operations at the Long Wharf would not affect this colony (Class III - less than significant).

Several California Species of Special Concern may be seen near marine terminals. These include double-crested cormorants, long-billed curlews, California gulls, some ducks, several species of foraging raptors (Order Falconiformes), the black swift, and several species of passerines (perching birds of the Order Passeriformes). Double-crested cormorants have an important colony on the Richmond-San Rafael Bridge near the Long Wharf. As discussed, a study determined that the reproductive success of this colony was similar to that of double-crested cormorant colonies in undisturbed areas (Stenzel et al. 1991). Numbers at this colony increased throughout the 1990's in spite of all the activities in the vicinity of the bridge; therefore, impacts on double-crested cormorants probably would be less than significant from Long Wharf operations (Class III).

Operations at the Long Wharf could contribute to the cumulative adverse impacts to sensitive species from the introduction of non-indigenous organisms. These potential impacts include competition, destabilization of the aquatic food web, accumulation of contaminants in the tissues of non-native prey species such as the Asian clam, and introduction of disease microorganisms or toxic algae. These impacts are cumulatively significant (Class I) and Chevron's contribution to the cumulative potential for introduction of non-indigenous species through ballast water discharges or hull fouling could be substantial.

Mitigation Measures for CUM-BIO-1:

CUM-BIO-1a. Chevron shall implement proposed Project MM WQ-2.

CUM-BIO-1b. Chevron shall implement MM CUM-WQ-1, all of the project specific mitigation measures described for the proposed Project to reduce the project specific impacts to water quality.

CUM-BIO-1c. Chevron shall implement proposed Project MM BIO-3a through MM BIO-3c.

Rationale for Mitigation: MM WQ-2 addresses implementation of the measure addresses requirements for Chevron to comply with the California Marine Invasive Species Act. However, effective systems for the treatment of ballast water to remove harmful organisms have not yet been developed. Mid-ocean exchange of ballast water is an interim measure.

MM-CUM-WQ-1 addresses Chevron's preparation of a SWPPP would help the Long Wharf reduce its contribution of contaminants into the water. In the long-term, documentation of vessels using TBT or other metal-based anti-fouling paints would help to reduce water quality impacts. Although Chevron may reduce it's contribution of pollutants to San Francisco Bay, the cumulative impact of degraded water quality, especially from urban runoff, is expected to remain significant. The development of Total Maximum Daily Loads for priority pollutants by the RWQCB and the implementation of Bay-wide measures to meet those loads will help to reduce cumulative significant water quality impacts.

MM BIO-3a through MM BIO-3c specify that Chevron reduce the potential for significant impacts to Dungeness crab juveniles, salmonid migration, and Pacific herring spawning by adhering to dredging windows established in the LTMS Management Plan.

Residual Impacts: Cumulative biological impacts in San Francisco Estuary would remain adverse and significant (Class I). Impacts to water quality may remain significant. If all dredgers adhere to dredging windows established in the LTMS Management Plan, potentially significant cumulative impacts of dredging to sensitive biological resources should be reduced to insignificant.

Impact CUM-BIO-2: Accident Conditions

Oil spills from all terminals combined, or from all tankering combined, may affect more resources than the Long Wharf operations alone, due to the wider distribution of potential sources of spills. Operations solely associated with the Long Wharf contribute relatively little to the cumulative risk of an oil spill. Even so, a spill from Long Wharf operations has the potential to impact biological resources and result in a significant adverse (Class I or II) impact.

Probability of Impacts

Cumulative conditions produce a greater threat that oil spills will occur than the risk from operations at the Long Wharf alone, because of the greater quantities of oil handled or transported, and the greater number of vessel calls (Section 4.1, Operational Safety/Risk of Accidents). Further, oil spills from all terminals combined, or from all tanker segments combined, may affect more resources than Chevron operations alone, simply due to the wider distribution of potential sources of spills. Based on the analysis in the Unocal EIR, Table 4.3-23 shows the final probability of oil spills occurring and contacting sensitive habitat from the cumulative, or combined, activities of all marine terminals and tanker transport. The potential for impacts is many times greater from cumulative terminals and tankers than from Chevron operations alone. For most resources the chance is at least 50 percent that they would be affected by one or more spills of 1,000 bbls or greater during the next 40 years. For some resources, the risk that they would be contacted by a small spill is near certainty. For spills of 10,000 bbls or more, the chance ranges from about 13 to 45 percent for impacts from one or more spills during the next 40 years. Along the outer coast, the probability that a resource would be contacted by oil from a tanker spill is much greater if all tankers are considered rather than Chevron tankers alone. The cumulative probability that widely distributed species like double-crested cormorant colonies would be contacted by a 1,000- to 10,000-bbl spill from a tanker off the outer coast is about 60 percent.

Table 4.3-23
Final Probabilities of Oil Spills Occurring and Contacting Sensitive Populations or Habitat Within a 40-Year Period from the Cumulative or Combined Activities of All Marine Terminals and Tanker Transport

Sensitive Habitat	Final Probabilities[1] (percent) Cumulative Barrels >1,000	Final Probabilities[1] (percent) Cumulative Barrels >10,000
San Francisco, San Pablo, and Suisun Bay		
Birds		
shorebirds - mudflat foraging habitat	73.2	23.0
waterfowl - open-water habitat	73.2	23.0
western gull - colony sites	97.6	44.2
Marine Mammals		
harbor seal - haulout sites	74.4	30.2
Fishes		
white sturgeon habitat	26.0	4.6
Chinook salmon habitat	96.5	44.8
American shad habitat	99.9	45.4
herring spawning areas	99.5	45.5
Invertebrates		
juvenile Dungeness crab (April-May)	99.9	45.5
juvenile Dungeness crab (September-December)	99.9	45.5
Other Sensitive Habitats		
eelgrass bed	92.7	40.5
vegetated tidal marshes	99.9	45.5
shallow water habitat	99.9	45.5
Rare/Threatened/Endangered Species		
California clapper rail and California black rail - breeding habitat	48.4	19.1
California least tern - colonies	42.6	13.1
double-crested cormorant -		
colony sites	84.7	33.9
open-water habitat	99.9	45.5
common loon - winter open-water habitat	50.0	22.7
long-billed curlew - mudflat foraging habitat	73.2	23.0
brown pelican - roosts	48.5	15.4
Barrow's goldeneye - open water habitat	73.2	23.0
Aleutian Canada goose - open water habitat	48.5	15.5
saltmarsh harvest mouse - tidal marsh habitat	99.9	45.5
Outer Coast		
Birds		
alcid colonies	17.7	8.0
storm-petrel colonies	6.2	2.8
cormorant colonies	60.9	27.5
western gull colonies	61.6	27.8
Marine Mammals		
harbor seal - haulout sites, 50 seals	30.8	13.9
California sea lion - haulout sites	28.0	12.6
northern elephant seal - colonies	7.3	3.3
dolphin and porpoise - open-water habitat	62.0	28.0
gray whale migration path	57.7	26.0

Table 4.3-23 (continued)
Final Probabilities of Oil Spills Occurring and Contacting Sensitive Populations or Habitat Within a 40-Year Period from the Cumulative or Combined Activities of All Marine Terminals and Tanker Transport

Sensitive Habitat	Final Probabilities[1] (percent) Cumulative Barrels >1,000	>10,000
Other Sensitive Habitats		
Areas of Special Biological Significance (ASBS)	53.6	23.8
salmon streams/rivers	25.2	11.2
rocky shore and offshore rocks	61.9	27.5
estuaries	3.7	1.6
upwelling areas - February through July	31.1	13.8
Rare/Threatened/Endangered Species		
common loon - nearshore waters	30.9	13.7
California brown pelican - roosts >100 birds	13.6	6.2
Steller sea lion - rookeries and haulouts	12.5	5.7
blue/fin/humpback whales - Gulf of Farallones habitat	20.5	9.2
sea otter range - north of Monterey Bay	14.3	6.4

[1] Final probability is the product of the probability that an oil spill will occur and the probability that, if it occurs, it would contact a particular sensitive resource. Final probability is multiplied by proportion of year sensitive resource is present.

Although the overall absolute probability that some portion of a resource would be contacted by a spill during the lease period is higher when the cumulative impact of all terminals and tankers is considered compared to activities at the Long Wharf alone, the relative risk generally does not change. The relative risk considers the percentage of a resource that has a high probability of being oiled should a spill occur. Thus, there is a much higher chance for most resources that they would have some contact with oil from some spill during the next 40 years when all terminal and tankering activities are considered, but once a spill has occurred the risk that a substantial portion of the resource would be contacted by oil does not change.

Although the probability of contact by oil spills is greater for cumulative conditions, the severity of impacts of individual oil spills is of the same scale as for the Long Wharf. The reasonable worst-case spill scenarios used above to describe potential impacts from Long Wharf activities apply as well to impacts that would likely occur from cumulative terminals or tanker transport.

As discussed in Section 4.1, Operational Safety/Risk of Accidents, the annual probability of spills from the Long Wharf accounts for approximately 36 percent of the overall probability of spills greater than 238 bbls from marine terminals within the Bay. Based on the estimated mileage traveled within the Bay, vessel traffic associated with the Long Wharf accounts for approximately 15 percent of the total probability of a spill from tanker and tank barge traffic in the Bay. Therefore, operations associated with the Long Wharf contribute substantially to the cumulative risk of an oil spill. For the biological resources of San Francisco Bay, the worst situation would be if two or more oil spills occurred within a short time. In this worst-case situation, the total percentage of a sensitive resource affected by oil might be substantially greater than if spills occurred infrequently enough that recovery occurred between spills. The analysis in Section 4.1, Operational Safety/Risk of Accidents, indicates that the mean time between spills of 1,000 bbls or greater was 29 years or more. Therefore, it is unlikely that resources would be contacted by more than one oil spill during the 30-year life of the lease.

Mitigation Measures for CUM-BIO-2:

CUM-BIO-2 Chevron shall implement proposed Project measures and MM BIO-6a through MM BIO-6g.

Rationale for Mitigation: The measures detailed in BIO-6a-g increase response capability and reduce accident risk. These measures specify that Chevron identify specific measures to protect sensitive resources near the Long Wharf in the event of a spill and consultation about cleanup actions with CDFG and USFWS will avoid damage that could occur during cleanup operations. Documentation of damage from oil spills would also provide data to determine the effectiveness of a cleanup and to help determine any necessary compensation. These measures help to reduce oil spill impacts to biological resources. For small spills of less than 50 bbls, impacts to biological resources can be reduced to adverse, but less than significant.

Residual Impacts: Cumulative biological impacts in San Francisco Estuary would remain adverse and significant but the Long Wharfs' contribution to most impacts to biological resources is small compared to other sources. Impacts from large spills would remain significant (Class I).

Table 4.3-24 summarizes Biological Resources impacts and mitigation measures

Table 4.3-24
Summary of Biological Resources Impacts and Mitigation Measures

Impact	Mitigation Measures
BIO-1: Disturbance on Fishes, Birds and Mammals from Vessel Traffic Movements	**BIO-1:** No mitigation required.
BIO-2: Sediment Disturbance to Benthic Habitat from Vessel Maneuvers	**BIO-2:** No mitigation required.
BIO-3: Maintenance Dredging	**BIO-3a:** Schedule dredging to avoid the months when juvenile Dungeness crabs are most abundant in the project area. **BIO-3b:** To avoid impacts to Pacific herring reproduction, schedule dredging to avoid the herring spawning season. **BIO-3c:** To protect the salmon, schedule dredging when winter and spring run Chinook salmon smolt activity is lowest.
BIO-4: Introduction of Non-Indigenous Species	**BIO-4:** MM WQ-2a and MM WQ-5 apply.
BIO-5: Contaminants Associated with Routine Operations	**BIO-5:** No mitigation required.
BIO-6: Oil Spills at Long Wharf and Along Tanker routes	**BIO-6a:** Implement MM OS-3a-d and MM OS-4. **BIO-6b:** Demonstrate to California State Lands Commission that Chevron can successfully implement its Oil Spill Response Plan and can deploy protection boom within 3 hours. **BIO-6c:** Procedures to be in place to flush double-crested cormorants from oil contaminated water. **BIO-6d:** Chevron shall ensure that adequate equipment and personnel are available to protect marshes. **BIO-6e:** When a spill occurs, develop procedures for clean up of any sensitive biological areas contacted by oil in consultation with CDFG and USFWS. **BIO-6f:** If damage occurs, the last resort is restoration and compensation. Document lost resources; determine sampling plan prior to spills. **BIO-6g:** Implement MM OS-7a and MM OS-7b.
BIO-7: No Project Alternative	**BIO-7:** No mitigation required.
BIO-8: Full Throughput via Pipeline Alternative	**BIO-8a:** Chevron shall perform biological surveys of proposed pipeline routes and if any sensitive resources are identified along the route, Chevron shall prepare and implement a mitigation plan to avoid impacts to those resources. **BIO-8b:** Chevron shall develop a plan to contain spilled oil and protect sensitive biological resources in the event of an oil spill.
BIO-9: Conceptual Consolidation Terminal Alternative	**BIO-9:** Implement MM BIO-8a and MM BIO-8b.

Table 4.3-24 (continued)
Summary of Biological Resources Impacts and Mitigation Measures

Impact	Mitigation Measures
CUM-BIO-1: Routine Operations	**CUM-BIO-1a:** Implement MM WQ-2 **CUM-BIO-1b:** Implement MM CUM-WQ-1, (MM WQ-2, MM WQ-5, and MM WQ-7 through MM WQ-11. **CUM-BIO-1c:** Implement MM BIO-3a-c.
CUM-BIO-2: Accident Conditions	**CUM-BIO-2:** Implement MM BIO-6a through MM BIO-6g.

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